PREVENTIVE AND CORRECTIVE PHYSICAL EDUCATION

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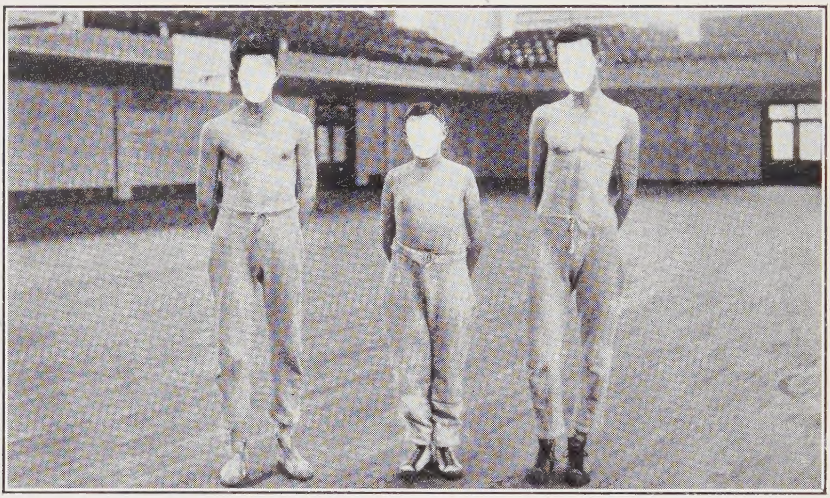

"Do Individuals Differ?"
(Three College Freshmen)

Preventive and Corrective Physical Education

By

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ILLUSTRATED

NEW YORK
A. S. BARNES AND COMPANY
1934

PREFACE

Attention is being focused on the physically defective individual to-day more than ever before in the history of physical education. Immediately prior to the outbreak of the World War, colleges of physical education in this country were not stressing the preventive and corrective side of their physical education program. A physical educator of fifteen years ago found little practical use for an extensive knowledge of preventive and corrective physical education. Without doubt more attention should have been given to the physically subnormal group, but the emphasis at that time was on physical education for the normal group.

Accompanying the hystericism for better health, which was manifested shortly after the outbreak of the war, there was inevitably an augmented interest in physical education as one of the means of raising the health standard of the country. The desire to be healthy became fashionable. Although to-day physical education is not heralded as a panacea for all conditions of ill-health, yet we must admit that prior to the World War, we Americans as a whole were not exercising sufficiently to keep our bodies in good condition. The emphasis to-day is on striking a balance between work and play: between mental efficiency and physical efficiency. Thus physical education is being called upon to do its share in raising the health standard of ALL the people. It cannot simply confine its attention to a comparatively few athletes.

With this increased interest in health and physical education the physical educators are confronted with the problem of supplying an adequate, and at the same time a safe, program of physical education for both the defective and the normal individual. The attempt to give every individual the same type and the same dosage of physical education, in hopes that the needs of all will be fulfilled, shows a failure to recognize individual differences. In many cases where mass physical education is administered, the work is too hard for a great many, is not hard enough for many more, and is satisfactory for only a few individuals.

The aim of this book is to furnish the reader with necessary information for giving the physically defective individual the proper type and amount of physical education to meet his needs and capacity. Stress is laid on the practical side of the work. Elaborate but often impractical theory has been carefully avoided. Emphasis is given to the necessity for prevention of defectiveness, for protection in cases where correction is either impossible or

inadvisable, and finally for corrective and remedial measures as they fit the individual case.

The material of this book is based on the practical experience of the author as a teacher of physical education in secondary and elementary schools, as a teacher of physical education in the United States Army in camps both here and abroad where corrective exercises were given to the disabled soldiers, as director of corrective and remedial exercises in a private institution of physiotherapy, and, since 1923, as director of corrective and remedial physical education for university students.

As a result of this experience with people of different types and ages, the author feels that too much stress cannot be given to preventive, corrective, and remedial work for the very young child. This conviction is substantiated by the following observable facts:

First—A child who is sent to school in good physical condition stands a much better chance of reaching maturity in good health than one who enters school physically or mentally defective—or both.

Second—A child with physical defects is not normal. He develops abnormal habits. The longer the child remains handicapped by the defects the more persistent the abnormal habits become. The more firmly the abnormal habits are established the more difficult is the correction of these abnormal habits even after the cause has been removed. The correction or removal of the physical defects does not necessarily result in the correction of the abnormal habits. For example, an undernourished child with very poor body mechanics is treated for his undernourished condition. Even after the malnutrition has been corrected, the poor posture tends to remain.

Third—The older the individual, the greater is the difficulty of correction both of the defects and of the abnormal habits which are caused by the defects. Work with college students and adults is largely a "repair" process. Defects are of long standing and abnormal habits are firmly established. In many cases the defects have reached the stage where they are incorrectable. In these cases the best that can be done is to protect from further deformity or deterioration.

As many of the difficulties which are considered within the scope of preventive, corrective, and remedial physical education have their origin in faulty health habits in early childhood, much space is devoted to discussion of this important phase.

A careful study of the history of corrective exercises reveals the fact that the subject is not of recent origin. The benefits of massage, heat, water and exercise were known to the ancients. But although the pioneer work of Per Henrik Ling, Branting, Hjalmer Ling *et al.,* must not be overlooked, relatively little progress was made in the development of corrective exercises until the twentieth century. It may be more accurate to say that the greatest develop-

ment in preventive, corrective and remedial physical education has come since the World War.

In preparing this book the author has studied and used various systems. The gist of the writings of many prominent men and women in the field of corrective gymnastics has been given in an attempt to bring the subject up to date. Much of the impractical and less important material has been omitted. The particular application of the ideas gleaned from the systems and the writings of other specialists are his own; and he alone must be subject to whatever criticism these applications may deserve on account of their defects.

It is hoped that this book will serve as a guide for physical educators, especially those who graduated from colleges of physical education before corrective work was given. It is further hoped that it will be a source of information to parents, teachers, nurses, doctors and all other health workers who are interested in the problem of raising the health standard of the physically defective individual. To create a further interest in this important health work a list of collateral readings is given at the end of each chapter.

The author wishes to express to the doctors in the Health Service of the University of Illinois, and to Dr. J. H. Beard in particular, his sincere appreciation of the spirit of coöperation which they have manifested.

Grateful acknowledgment is made of Doctor Charles LeRoy Lowman's helpful suggestions and constructive criticisms in the final preparation of this manuscript.

G. T. S.

URBANA, *Illinois*, 1928.

FOREWORD

A decade ago many college and universities provided physical education for the physically normal student only. As there was no place where the abnormal individual might receive systematic exercise he was excused from all work. The subnormal, the organically sound but asymmetrically developed, the underweight, and the potentially defective, were either permitted to forego gymnastics entirely or were required to take the regular prescribed course. Thus, those who needed physical education the most were neglected and those who required it the least received further training.

The findings of the draft, the phenomenal results obtained in the physical rehabilitation of soldiers during the war and the slogan of "athletics for all," stimulated a demand that physical education in institutions of higher learning should give the physically defective student the benefits of corrective and remedial exercise in accordance with the sound principles of orthopædics and physiotherapy under competent supervision. As the periodic physical examination becomes a routine measure in preventive medicine carefully prescribed physical activity will be used more and more to promote health and efficiency.

The purpose of education has broadened not only to make the most of the individual morally and mentally, but also to include the thorough development of his physical resources. In motivating, propagating and in rendering practical this comprehensive ideal of the mission of education, Professor Stafford has been a tireless worker. It is, indeed, fortunate that teachers of physical education and those interested in the activity aspects of preventive medicine have available his experience in so interesting a text as "Preventive and Corrective Physical Education."

J. Howard Beard
University Health Officer.

Urbana, Illinois, *October* 30, 1927.

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INTRODUCTION

Early in the present century the influence of Per Henrik Ling's work in "medical gymnastics" was felt in America. The prevalence of infantile paralysis, starting in 1907 and reaching its height in the epidemic of 1916, revealed the great value of corrective gymnastics for muscle reëducation in limbs which had been paralyzed. Following the 1916 epidemic, the shameful figures of the draft report further awakened physical educators and all the medical profession to the need of therapeutic exercises in the treatment of physically defective individuals.

Infantile paralysis left thousands of cripples. Many cases in the 1916 epidemic were never reported. Of the 27,000 reported cases, it is estimated that twenty-five per cent. were fatal. The seventy-five per cent. who recovered were more or less crippled. Without proper muscle training prior to the operable stage which is, according to Lovett, a good many months after the onset of the disease, thousands of individuals were doomed to remain cripples. With proper after-care it was found possible to restore to nearly normal function much of the musculature which had been affected by the disease. The importance of corrective gymnastics was clearly demonstrated in the reëducation of paralyzed muscles. Muscle training by active exercise is one of the physical measures most important in restoring function to limbs which have been affected by infantile paralysis.

The draft report showed that nearly one-half of our young men were defective in their physical or mental make-up. When vigorous, healthy, well-developed, athletic men should have predominated, they were the exception rather than the rule. The failure of the narrow athletic type of physical education program which took care of only a small minority—those who already were in good condition—was very evident. Moreover, the splendid results obtained by physical exercise and other physical measures, in work with soldiers who had been injured, showed the possibilities of using physiotherapy in its various branches for the correction of defects and deformities found in civil life.

Since the close of the World War the demand for a higher standard of health, and for physical education for ALL has been growing. It was a distinct shock to many a man to learn that his physical condition was so poor that he could not pass the army examination. It was a distinct shock to many of the newly made soldiers who barely passed their medical examina-

tion to find themselves quite unfit for the vigorous life of a soldier in war times. Only by graduated exercises did these poorly developed and organically weak individuals develop into more vigorous and healthier men. And they have profited by their experiences. They are giving more time to exercise and play. Their children are offered a better chance to develop normally in body as well as in mind. Older men are realizing the folly of premature physical deterioration which accompanies failure to maintain a reasonable health standard. The lure of wealth is being seriously challenged by the lure of HEALTH.

These demands for better health and for physical exercise for ALL have caused a subsequent call for teachers of physical education who can teach also the preventive, corrective, and remedial branches of physical education. Colleges of physical education are including corrective and remedial gymnastics in their curricula. There is yet, however, a serious shortage of physical educators possessing the knowledge and experience necessary to carry on the corrective and remedial work in colleges, secondary schools and elementary schools. The greatest need is in the elementary schools.

The demand for a higher health standard has been felt by the medical profession. Preventive medicine is no longer idle theory. The emphasis on periodic health examinations is a step in the right direction. Unfortunately the medical curricula of to-day were devised by men of the past, and for this reason the student in many "Class A" medical colleges can get but sixteen hours of physiotherapy, or non-medical therapeutics. Although the value of physiotherapy as a health measure was definitely demonstrated in the World War, yet unfortunately, following the war, not enough reputable medical doctors were prepared to incorporate physiotherapy as a part of their therapeutic armamentarium. Then, too, some medical men became over-enthusiastic in their claims regarding the value of a certain type of physical treatment and based favorable reports on too few cases. Pseudo-scientists have used physical remedies incorrectly and without the proper medical treatment where necessary. The results have been disastrous in too many cases. For this reason many of the more conservative medical men have condemned physiotherapy.

According to the editor of the *Journal of the American Medical Association,* "An investigation of the curricula of medical colleges indicates that few are ready to give courses in this branch (Physical Therapy) of medical treatment." Commercial courses, offered by concerns manufacturing electrical apparatus, are "tainted with commercialism." On the other hand "schools of medicine and post-graduate schools offer but few courses, and those not continuously."[1] Some of the text books on electro-therapy are

[1] Fishbein, M., "The Council of Physical Therapy," *Journal A.M.A.*, 86:272-4, January 23, 1926.

referred to as "undergoing a process of development which make difficult dependence on any one of them." In fact, the author of one certain book is mentioned by Doctor Fishbein in the following pert manner: "It is presumed that the gentleman who wrote this statement is now more gainfully employed selling lots in Florida."

The above paragraph, which refers largely to the use of electricity in treating abnormal conditions, must not be interpreted to mean that the medical profession refuses to use physiotherapy. They are using it. The value of physiotherapy is known to thousands of reputable physicians. No hospital can claim to be modern that does not have its department of physiotherapy. Some short term courses are offered to licensed practitioners. Columbia University is listed as one of the colleges offering six weeks of daily clinical work with suitable lectures. Leland Stanford, Rush, Harvard and others have followed suit. But owing to the shortage of medical men who should be caring for the electro-therapy branch of physiotherapy, and the shortage of physical educators who should be handling the massage and exercise branches, there are many unscientific and ignorant charlatans and quacks who are taking advantage of the unpreparedness of doctors and physical educators, to launch upon the unsuspecting and gullible public all forms of unscientific physical treatments. The chaff is gradually being separated from the wheat. As more medical men and more physical educators are trained in their respective branches of physiotherapy, the unscientific operators will gradually find themselves forced out of business because of their inability to compete with scientific therapeutic methods. The branches of physiotherapy which have been and will continue to be handled by physical educators are those of massage and therapeutic exercise and certain phases of heat and water treatments. A more thorough understanding of these modalities is necessary if the physical educator is to be regarded as worthy of a place in the more scientific physiotherapeutic work of the future.

There has been in the past an over-emphasis on the work with athletes, which has resulted in a neglect of those who really need physical education the most. This mistake must be and is being remedied.

Physical education must be interpreted in larger terms than athletics. Athletics is one branch of physical education—not the entire field, as many think. No program of physical education meets the needs of the majority of students if it does not provide proper provision for the development of physical strength and vitality of ALL the individuals, in accordance with the demands and exigencies of their daily life. A scheme of physical education which stresses only athletics may train and equip a few players to win a few games, but this cannot be called physical education. To warrant a place in any curriculum, physical education must equip the individual for

life. Athletics should send a man from college "abstemious in habits, with a vigorous and undilated heart, a strong, agile and well controlled body, a delight in big muscle activities for their own sake, a fondness of out-of-door life, and finally a more or less intimate knowledge of the human machine." [1] The over-emphasis on athletics has led to the oft-repeated criticism that from the physical-betterment standpoint regular gymnastics are superior to competitive sports.

Too much time and effort is being spent on athletics—athletic worship and specialized training—to the neglect of the majority of individuals who are not able to participate in the more vigorous activities. The athlete has been carefully trained, and the worst cripple has been treated but the great "middle class" between these two extremes has been neglected. This group too has a claim on our attention and efforts and needs intensive training on such fundamentals as proper body mechanics, proper breathing, proper assimilation, proper use of the body, etc. It is with this "middle class" that the preventive work is necessary. The athletes who are now, and have been, receiving intensive training are those who are least in need of training. Might it not be well to consider the advisability of teaching ten men how to walk properly, thus preventing weak feet, fallen arches and subsequent bodily fatigue, against our present system of attempting to teach one high jumper how to clear the bar at six feet or better? Would it not be better so to train fifty men that they would have the endurance and strength and coördination to run one mile in fair time, rather than to concentrate that attention on the development of one star miler—while the forty-nine stand aside and grow weaker?

Athletics do not cater to the weaklings. Athletics are said to promote health and physical vigor; it might better be stated that in our present organization athletics are the result of health and physical vigor. Since there is an abundance of good material in the average university, there is very little need to make use of the mediocre or weakling, and the athletic program does not include enough preliminary development work for those who are not naturally endowed with superior physiques. The athletic program takes care of the better group—and allows those who most need the development to shift for themselves. It is time to recognize the fact that a nation is not made up of healthy individuals simply because that nation is the highest point winner in the Olympic games. Physical education of the immediate past has shown intensified interest diverted almost exclusively to the gymnasium and the athletic field. It has not embraced, as it must, the other forms of health education for the masses. It has not given even satisfactory attention to the all important formation of proper

[1] Dawson, P., "To the Makers of a New Profession, Physical Education," *Amn. Phy. Educ. Review,* 30:551-5, December, 1925.

health habits. The great "middle class" of mediocre and border line cases must be taken care of by a more comprehensive physical education program.

The value of natural play activities is recognized by the exponents of preventive, corrective, and remedial physical education. One of the aims of the corrective program is to fit the defective individual so that he can take part in the joys and benefits of a properly conducted athletic program. We must open our eyes to the fact that, as a nation, we are not physically able to participate in the more vigorous athletic work. We are not maintaining even a passing health standard. One has but to review the draft report, or note the results of freshmen "health examinations" in our colleges and universities, or, worse still, review the examinations in our public schools, to see the low health level of our coming men and women. Our attention must be directed toward the physically defective and the sedentary individuals. The most of our attention and care must be given to the prevention of the deterioration of health and to the correction of existing defects. Then, there will be more individuals physically able to enjoy with benefit the athletic program, the out-of-door life, the play and recreation which are now strongly recommended.

Athletics, as commonly taught in America to-day, do not have the "carry-over" which distinguishes English athletics. The American athlete of to-day works for an excellence of performance which is often painful and which takes away much of the enjoyment from the activity. There is, of course, a small percentage of college youths who are endowed by nature with such a surplus of energy that they participate because of real enjoyment. But the average athlete is in the business to win. After the training season is over, he often lapses into a very low state of physical well-being. He becomes careless in matters of hygiene and health habits. One is often asked whether the college athlete is healthy in after-college days. Due to his superabundance of vitality which first led him into the athletic program, he is generally healthy. But his college has bequeathed him no means of remaining so. The English athletes may be defeated by the American athletes, but the former continue their athletic work with enjoyment, and on a health-maintaining scale, throughout adult life. This failure to teach "carry-over" games in American colleges is a serious error in our present athletic program.

Another fault often creeps into athletic work. Unfortunately the good physique of the athlete lends him a false assurance of security. Many athletes in the pink of condition can violate certain health rules and apparently suffer no consequences. A common example of this is the negative health habit of using the common drinking cup, or common dipper, or the team jug, during athletic contests. It is not unusual to see a sponge dipped into the drinking bucket, used to mop off blood or grime from some one's

brow, seized and sucked for a drink and then thrown back into the water bucket for the next man. The same water is then freely used by the other members of the team. This could not be called a sanitary practice. This and other habits of carelessness during athletic contests often result in the formation of faulty health habits which later become detrimental to health.

This criticism is offered, not as a condemnation of athletics, but as an appeal to "clean house." Athletics can aid in the formation of better health habits. Athletics can be a worth-while branch of physical education. One must thoroughly understand what physical education is trying to do. *The entire field of physical education, including athletics, should emphasize the development of the individual that he may function properly, avoid disease and thus fit himself for his life's work. This development is a part of the scheme of education.* Physical education, properly administered, should be the cornerstone of the educational curriculum. With proper emphasis on the health side in education the pupil goes forth from school with a well-developed mind and body.

This term "well-developed body" means that the functional power of each individual is raised to the highest level consistent with the individual's needs and capacity. Thus the coach or physical educator must first know the condition of each individual and to do so he must institute a careful health examination for every one under his direction. Then he must be able to develop a program of physical education which will meet the reqirements of the defective individual as well as the normal individual. He must educate the children and the parents and the community to the need of periodic health examinations and to the necessity of health-forming habits. His ultimate objective is the promotion of health as the means to an end. The end is a fuller and richer life.

The big task in the preventive, corrective, and remedial physical education program is to take care of the large number of individuals who do not ordinarily fit into the regular physical education program. Where an attempt is made to fit these individuals into the regular program, it is often attended with very poor results. This applies especially to the students with heart lesions, hernias, weak and flat feet, albuminuria, postural disturbances, etc. To be sure, many of these conditions are neither correctable nor curable by exercise, yet notwithstanding that fact, these students will be helped by corrective and remedial physical education. They will gain physically by exercises of a protective nature; their general development can be improved, and their organic efficiency and resistance to disease increased. From this work they will receive poise and reserve strength. Aside from the physical benefits to be derived, exercise will help the student mentally and morally. It will do much to remove from the student's mind the in-

feriority complex and defeatist philosophy that so often accompanies slight incurable conditions.

Formal gymnastics, often termed "Swedish Gymnastics," do not comprise the larger part of the corrective and remedial physical education program. Emphasis is laid on this type of work only in so far as it can develop thoroughness, discipline, physical alertness, and correct growth. A greater emphasis is given to the development of fundamental movements and reflexes of the body. Where poor body mechanics accompanies poor muscle tone, emphasis is given to the development of organic and skeletal vigor so that good body mechanics may become possible. The recreative instinct is appealed to by suitable plays and games within the individual's capacity. Great stress is laid on the acquiring of skill in natural activities which will tend to raise the level of health and efficiency to a point where the individual can take his place in the community as an asset, rather than a liability.

In order to conduct a program of preventive, corrective, and remedial physical education the director must be more than a star athlete. Nothing has hindered the development of physical education as much as the erroneous idea that because a man has been a professional boxer or a star football player, he will be able to guide the normal growth and organic development of the coming generation. The athletic star is often deficient in knowledge of educational methods and of physical education in its broadest sense. For him physical education means his particular sport or sports. He fails to realize that more care is needed for the students who cannot now engage in these sports, and he gives little or no attention to training in proper body mechanics. The physical education program must extend beyond sports. Exercises which promote and maintain good body mechanics and augment the functional power of the individual must be stressed chiefly. Then with this training as a safeguard and basis, sports can provide an intermittent outlet for physical energy and an opportunity for further muscular activity and training. The teacher of preventive, corrective, and remedial physical education, besides his knowledge of games, etc., must have a thorough knowledge of applied anatomy and physiology, abnormal phases of diet and nutrition, the metabolism of the body, kinesiology and hygiene (general, mental and child hygiene). He must also have a more practical conception of the neuromuscular system and disturbances of organic balance. A basic course in psychology and practical experience in health education are invaluable.

With a program which really builds men and women, raises them to a higher level of natural ability, and removes the removable physical handicaps, the coach or physical educator becomes a bona fide educator and takes his rightful place in the scheme of education. He recognizes the individual's

capacity, needs, and undeveloped talents, and he aims to build the individual up to the highest point of health and efficiency.

This emphasis on health as an integral factor in education is no longer necessarily stigmatized as radical. Since 1920 the investigations of the United States Government have resulted in various publications by the government, which speak of Health as MORE important than the three R's. No longer is it customary to burden a child with studies when the child's body will not bear the strain. The fundamental object of a child's education must be normal development and good health. The statement of G. Stanley Hall, "What shall it profit a child if he gain the whole curriculum and lose his health?" is worthy of serious consideration.

This Health Education is not the dry text-book variety of blood and bones, but actual practice in Health Habits. These habits are not simply habits to be performed in the presence of the teacher and then quickly forgotten but habits that the child practices throughout his daily life. This health education to be successful must conserve and promote the future health of the school child.

The problem of the physically defective must be faced squarely. It has been mentioned in theory for some years. Life to-day does not demand the excessive physical speed and great muscular development that it may have demanded in primitive times. We are educating for to-day and for to-morrow. We must stress the need of proper breathing, assimilation and elimination, and organic vigor as the basis of preventive and corrective work. The Greeks proved many hundreds of years ago that this could not be accomplished by competitive, specialized training. Medically supervised competitive training is needed. Fundamental training must be taught in the elementary and primary schools. The proper use of the body, the development of proper habits in breathing and standing correctly and in the care of the body, must be taught the coming generation. Where this has been neglected, physically defective individuals have resulted.

The proper development of the preventive, corrective, and remedial physical education program will go a long way toward meeting the problem of reducing the number of physically and mentally subnormal. It becomes the duty of each physical educator to see that those in his care are given proper medical examinations for determining their condition, and then to give vigorous and thorough follow-up work (not of the paper or statistical type) in order to make sure that the defects are remedied as quickly as possible. In this way the physical handicaps will be removed, the standard of health will be raised, and consequently the educational work in other school subjects of the curriculum will be permitted to progress and develop more efficiently.

In many cases the results of this work will show immediately. A great

deal can be done to train the individual who is not exactly in the cripple class and still is not in the athletic group, to use his body to better advantage immediately, to maintain better body mechanics, and thus to acquire and maintain more lasting health and vitality. In other cases the results will not show for a number of years. For example, a group of elementary school children may be so trained toward proper health habits by physical education methods that the results will inevitably be stimulation for precise thought and action, better neuromuscular control and refinement of the body function, though these results will not be plainly evident till the group reach high school and college. They will enter into their fields of higher education, however, with physiques and health habits which will make it possible for them to engage in athletic work with joy in their accomplishments and better health. This will result in better athletes and—what is more important —in better citizens building on the firm foundation of health and vitality.

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PREVENTIVE AND CORRECTIVE PHYSICAL EDUCATION

CHAPTER I

PHYSIOTHERAPY

The term physiotherapy is defined in Dorland's Medical Dictionary, as "the use of natural forces, such as light, heat, air, water and exercise, in the treatment of disease." Limiting it to these modalities allows it to be classified among the earlier remedial measures. "Baking and massage" no longer constitute an up-to-date conception of physiotherapy. The more advanced understanding of the term would include the use of the natural forces listed above, plus the use of certain forms of electricity. To define physiotherapy properly to-day would be to say that it is the scientific use of certain forms of light, heat, air, electricity, water, massage and exercise, in the treatment of certain abnormal tissues.

The results of the use of physiotherapy in treating those who were injured in the World War, and the gratifying results which are now being obtained by the use of physiotherapy in industrial injuries, have demonstrated the value of rational physiotherapeutic measures. *It must be understood, however, that physiotherapy is not a system to be used to the exclusion of other therapeutic modalities. It is not a panacea for all ills.* It has its limitations, but is a worthy additional unit to any physician's armamentarium. Combined with medicine and surgery, physiotherapy is a valuable ally in the treatment of abnormal physical tissues. For a better understanding of the scope of physiotherapy an epitomized survey will be given of the various branches:

I. LIGHT AND HEAT

These two modalities overlap to such an extent that they are generally discussed together. These are usually spoken of as "Thermic Agents." The radiant light and chemical rays of phototherapy and the radiant heat of thermotherapy are both useful for the purpose of:

A. Relieving pain by lessening nerve sensibility and relaxing spasm.

B. Stimulating local circulation and thus relieving congestion and effusion.

C. Producing vaso-dilation, perspiration and superficial hyperemia.

D. Increasing metabolic changes in superficial tissues.

E. Eliminating waste and promoting repair.

F. Acting as a preliminary for other physical modalities such as massage, electricity or exercise.

The large proportion of the infra-red rays, which are secured by the action of deep therapy lamps, are valuable in the treatment of different forms of trauma of tendons and muscles so frequently found in athletic injuries.

Radiant light and heat may be secured by the following:

1. Sun's rays.
2. Deep therapy lamps (tungsten, nitrogen or carbon filaments).
3. Diathermy.
4. Hydrotherapy (whirlpool baths, hot fomentations, compresses or packs).
5. Superheated air.
6. Hot sand or salt packs, ironing with a hot iron, hot plate.
7. Permanent cautery.

This form of treatment is being rapidly developed, but many questions are still open to debate. The theory of the penetrability of light for a depth of over one and seven sixteenths inches is not admitted. Heat may penetrate deeper, though it is generally admitted that heat is conveyed to the tissues and then taken up by the blood stream, resulting in a warming of the body. In general, acute conditions need sedative measures while chronic conditions call for stimulative or irritative measures.

II. WATER (Hydrotherapy)

The use of water for therapeutic purposes was known to the ancients. Hippocrates wrote that cold water warms the body and warm water cools the body. Hydrotherapy is the use of water in its various forms, for the purpose of alteration of the physiological, psychological and pathological bodily processes. The temperature, the circulation, the muscular system, the nervous system, the respiratory system, and the metabolic processes of the body can be affected by the use of water applied to the body. The nervous system can be stimulated or depressed by the use of water. The circulation is also very responsive to water treatments. The use of the

neutral bath (92 degrees to 96 degrees F.) for nervous individuals and for those who are unable to sleep, is well known.

The chief modification of the bodily processes sought in the use of water is that of temperature readjustment. Next in importance are the mechanical effects of water. The Scotch douche (100 degrees to 110 degrees F. and then switched to 80 degrees to 70 degrees F.) is stimulating, due to the contrast and the pressure of the water. This pressure usually averages 20 to 30 pounds. The whirlpool bath of 105 degrees to 115 degrees F., wherein water is constantly agitated by its own pressure or by compressed air, causes a profound effect upon the local circulation of the submerged limb. When the limb is subjected to the mechanical action of the whirlpool bath for twenty to thirty minutes, there results a gentle massage of the part, relaxation of muscle spasm, relief of pain, and an increase in the circulation, with increased elimination following. In fracture cases, following the removal of the cast, prompt relief from pain and diminution of stiffness and swelling result from the use of the whirlpool bath.

When the expense of the constant and abundant supply of hot water, which is necessary in the whirlpool bath, cannot be met, the contrast bath is often found useful in athletic injuries. The limb is immersed in a bucket of water at a temperature of 120 degrees F. and then immersed in another bucket of water at a temperature of from 80 degrees to 60 degrees F. The duration of the immersion is thirty seconds in the hot and ten seconds in the cold, increasing the dosage until the limb is held in the hot for one minute and in the cold for a half minute. The procedure should be repeated for not more than ten minutes. The vasodilation and vasoconstriction from the hot and the cold applications increase the tone of the injured part.

III. ELECTRICITY (Electrotherapy)

Electrotherapy, as one branch of physiotherapy, belongs entirely to the physician. A few minutes' conversation with a clever electrical apparatus salesman may give one the impression that any one can, by following the printed directions which come with each machine, administer to various ailments of the body. But more careful study of electrotherapy reveals the vastness and the complexity of the field, and awakens one to the realization that only with a complete diagnosis of the condition plus a thorough understanding of the body and the best technique such as only a physician has, can one hope to administer electrotherapy to the best interests of the patient. The physical educator should have this realization and, possessing a general knowledge of the subject, consider himself only a helper of the physician.

The forms of electricity used in physiotherapy are:

1. High Frequency.
2. Faradic.
3. Galvanic.
4. Sinusoidal.

Electricity is used mainly in physiotherapy for the purposes of:

A. Producing heat (Diathermy, Radiant Light and Heat).

B. Producing chemical effect (Actinotherapy, Continuous Galvanic).

C. Producing mechanical action on the tissues of the body (Faradic, Sinusoidal and Static).

D. Producing favorable psychical influence.

A. Heat Producing Type of Electrcity

Diathermy. The high frequency current used in diathermy, though of more recent origin than the faradic, galvanic or even the static, is a very valuable agent in the treatment of injuries of an industrial or athletic nature. The bipolar d'Arsonval high frequency current known as diathermy is an oscillating current with high frequency (almost a million per second) with sufficient voltage to overcome the resistance of the tissues being treated and with relatively high amperage to heat the tissues through which it passes. The current passing through the tissues is converted into heat. The heat is produced within the deeper tissues of the body in proportion to the tissue density (resistance of conductor) and the intensity of the current. Bone, being denser than soft tissues, offers greater resistance, and greater heat is secured by a given current than when this same current is applied to soft tissues.

The current used in diathermy has no power to contract muscles. The only sensation which the patient feels is gentle heat within the tissues. The blood vessels beneath the electrodes are dilated; deep hyperemia disintegrates exudates; the temperature of the body is slightly elevated due to the distribution of heat by the body fluids; and the processes of elimination and metabolism are stimulated. The facts that the size of the electrodes may be varied and that the current takes a direct path enable the operator to heat a given point or portion of the body. This is accomplished in the following manner:

The greater the difference in the sizes of the electrodes, the nearer to the smaller electrode will be found the point of most intense heat. The dosage rarely exceeds 80 milliamperes per each square inch of the smaller electrode surface. See Fig. 1.

Diathermy is used as a stimulative agent or as a sedative agent. The stimulative effect is caused by "stepping" the current up rapidly and reducing it to almost zero very rapidly. This is used to stimulate the

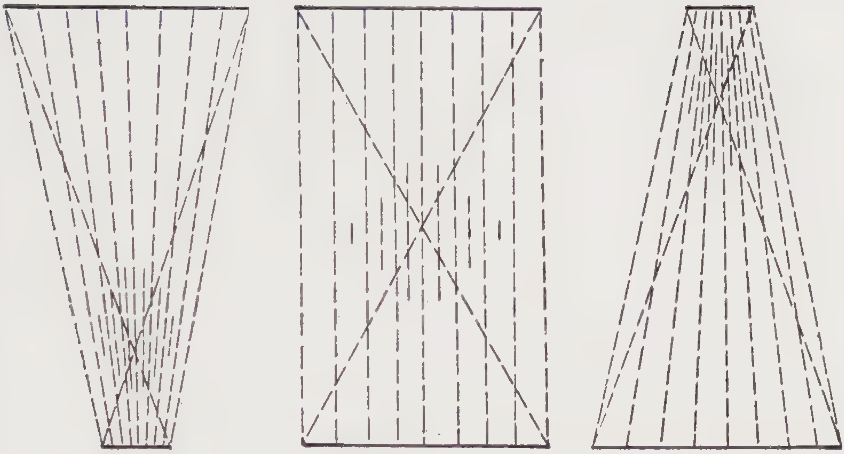


FIGURE 1

Internal Heat by Diathermy

(Greatest heat in area of more profuse shading)

osteogenetic action in fracture cases. The bone ends are irritated, and callus formation is augmented.

The sedative effect of diathermy is the more common form used in physical education work. In this form of diathermy a continuous and steady heat is generated within the affected parts, causing an increased blood supply to the deeper tissues. In the sedative type of diathermy the current is "stepped up" very gradually and lowered in one half the time required to raise it to its maximum.

Diathermy is beneficial in many of the injuries found in athletic work. For example, it:

Relieves venous congestion.
Stimulates vasomotor mechanism.
Retards bacterial propagation.
Relieves pain.
Hastens the formation of callus in fractures (stimulative).
Absorbs excess callus (sedative).
Increases blood supply where needed.
Supplies heat within injured parts.
Stimulates metabolism and elimination and hastens repair.

Diathermy is used extensively for sprains and strains and muscular injuries.

Diathermy is contraindicated in acute non-draining infections and walled-in pus where there is liability of hemorrhage as in tuberculosis proc-

esses. The indiscriminate use of diathermy in paralysis cases cannot be censored too strongly. When a doctor has prescribed diathermy the operator should be constantly in attendance upon the patient during the treatment.

For best results diathermy should be followed by one or more of the other physiotherapeutic modalities such as massage, exercise, or another form of electricity.

B. Chemical Action Type of Electricity

1. *Actinotherapy or Ultraviolet Rays.* These rays are beyond the violet part of the visible spectrum. The sun's rays are divided as follows:

Visible light	13 per cent.
Infra-red (heat)	80 per cent.
Ultraviolet	7 per cent.

The use of mercury vapor increases the ultraviolet per cent. to 28. The ultraviolet rays are strongly actinic and have the power of bactericidal and chemical action to a marked degree. Under proper modification these rays are found beneficial in nourishing and stimulating tissues and relieving pain. In stronger doses their action is bactericidal.

The definite action of the ultraviolet rays on cellular activity is not generally agreed upon. There is the feeling, however, that the rays may be made to penetrate the skin and are thus taken up by the capillary circulation. As most of the results secured thus far are mainly empiric, one must proceed with caution in expounding the benefits of the ultraviolet rays. There is apparently sufficient evidence to establish the value of ultraviolet rays as an important prophylactic and therapeutic factor in cases of rickets. Inorganic phosphorus and the calcium content in the blood are both increased after the proper application of ultraviolet rays. The increase in the hemoglobin count due to the action of the sun's rays, and the better defense mechanism against bacterial infection following exposure to the ultraviolet rays, are not generally agreed upon but seem to warrant further study and consideration.

For athletic injuries, cases of malnutrition, sluggishly healing wounds and many local skin infections the ultraviolet ray is indicated. In some of the larger universities throughout the country the air-cooled apparatus is a part of the training equipment in varsity athletic work. When a doctor is in charge of the training of athletes, there are, no doubt, great possibilities for the use of the ultraviolet rays in athletic injury work. As with the other physiotherapeutic modalities a very accurate diagnosis, definite dosage and skilled technique are essential for successful results from the use of the ultraviolet rays. The medical doctor is the one who should administer or at least closely supervise the administering of the various electrical modalities.

2. *Galvanic Current.* The chemical action is the main feature stressed in the continuous galvanic current. In the interrupted galvanic current muscle contractions result. In the use of the continuous galvanic current the chemical effects, due to the polarity of the current (current flows from positive to negative pole), give the following results:

Positive pole causes a sedative action of nerve endings, thus relieving pain. It also acts as a vaso-constrictor agent, thus stopping hemorrhage. It soothes inflammatory conditions.

Negative pole causes stimulation. It is irritating and acts as a vaso-dilator.

C. Mechanical Action of Electricity

1. *Faradic Current.* This is one of the oldest electrical currents. Its action is mechanical in effect. By this current the nearest approach to a normal motor nerve impulse to a muscle is secured. The series of muscular contractions are secured by the current stimulating the nerves themselves. The contractions, being of one thousandth of a second duration, are useful for reëducating muscles which have been inactive for a long time and for aiding circulation and nutrition which are poor. This current is NOT used on a muscle which is paralyzed. Its particular advantage lies in work with flabby but not paralyzed muscles. The Bristol Coil is used quite frequently in work with flabby muscle groups. In partially paralyzed muscle groups the faradic current is sometimes used, but it should be borne in mind that too many stimulations to a weakened muscle do a great deal of harm. It is much more satisfactory to begin with two or three stimulations and gradually work up to ten or fifteen, in a series, than to start with the larger number.

One of the common methods of faradic treatment for obesity in sanitariums is mechanical stimulation of obese parts by means of a special semi-reclining chair with large metal electrodes under the back, legs, and arms. By the aid of sandbags placed on the abdomen and other extra-fleshy parts of the body the greater part of the musculature of the body is brought into slow contractions. For those people who are obese and, because of some organic difficulty such as heart condition, cannot take active exercise, the results are very beneficial. For the obese individual who is naturally lazy this is an ideal manner in which to reduce at a rate of from one-half to one pound per day. With the use of this chair the diet, however, must be considered as well as the exercises.

2. *Sinusoidal Current.* In physical education work the sinusoidal form of electricity is used for paralyzed muscles. The object is to preserve existing deficient contraction function, bring further nourishment to the part, and prevent further deterioration until the muscle regains its connection

with its energy center. The action of the surging current is a slow wave of from 10 to 170 cycles per minute. An electrical current of this type is at first more effective in paralysis cases than either massage or exercise. When the part has been properly prepared by diathermy or some other thermal modality, this current strengthens and improves function in the relaxed and atrophied parts. The sinusoidal current is thus reserved for paralyzed muscles and the faradic (Bristow Coil) for weak but NOT paralyzed muscles. This current is contraindicated in sub-acute and acute inflammations.

Caution must be exercised in the use of all the electrical modalities against fatiguing the part worked upon. A few contractions are much more effective than a great number of contractions which fatigue and weaken muscles and thus cause further deformity because of the unrestricted action of the normal muscles.

3. *Static.* This is a current of high frequency with high voltage and low amperage. It produces very fine continuous, painless, molecular massage. It is used where hand massage would be too severe. The different types of static current are:

Effluve (brush discharge or blue pencil).
Wave (Morton Wave).
Sparks.

Preceded by some form of thermal treatment which prepares the part by softening the tissues, this modality is useful for the purpose of:

Removing circulatory congestion.

Pumping out extravasated fluid in acute injury, thus preventing the organization of this fluid as in sprains.

Relieving conditions of organized exudate.

Decongesting congested tissues.

IV. MASSAGE

Massage may be defined as the scientific manipulation or handling of the soft tissues of the body for therapeutic purposes. This manipulation is not to be confused with the indiscriminate "rubbing" and rough manipulation which accompanies many "Turkish Bath" procedures, and which forms, in too many cases, the bulk of the athletic trainer's armamentarium. There are five generally accepted manipulations in scientific massage:

A. Effleurage (stroking).
B. Pétrissage (kneading).
C. Friction (as named).
D. Tapotement (striking, hacking or percussion).
E. Vibration (as named).

The marked advance in the development of other physiotherapeutic measures has limited, to a certain extent, the former wide usage of massage. But in connection with other physiotherapeutic modalities massage takes an important place. Massage itself cannot be said to restore strength to weak muscles; neither can it take the place of active exercise in restoring function; but preceded by some thermal agent it is indicated for the following purposes:

For increasing metabolism.
For improving the circulation. (It is generally used following diathermy.)
For assisting in preventing atrophy.
For hastening absorption.
For relieving and allaying stiffness and adhesions.
For relieving pain.

V. CORRECTIVE AND REMEDIAL EXERCISES

Our present scheme of civilization is beset with marked limitations and restrictions in motor activity. The result is a marked deterioration in general physique and well-being. The very fact that we need so many artificial means of physical therapeutics is evidence of the fact that we have not been taking advantage of our natural sources of health and well-being. The efficiency of the body and its vital organs, as portrayed by the erect carriage and efficiency of the muscular system, is appreciated by but very few individuals. The average person in adult life is not prone to exercise his muscles. Man-made machines have gradually relieved us of our natural opportunities for physical activity. The result is that to-day our realization of this lack, for years past, of physical activity is driving many individuals into the gymnasiums and on to the athletic fields in an earnest endeavor to make up, by intensive effort and exercise, this lack of physical activity.

Educators and doctors are willing to admit that physical education has something worth while to offer as an important branch in our health work. The student does better work in his studies if he is allowed time and space for physical exercise and recreation. The individual whose ill-health has been caused, to a large degree, by failure to exercise his body is being sent by the physician to the gymnasium for corrective and remedial exercise. It is the duty of the physical educator to be prepared to handle this influx of defective and physically subnormal individuals.

Corrective and Remedial Physical Education has for its objectives:

A. The restoration of the weak and under-exercised individual to the point where he can indulge with benefit and pleasure, in the various recreational activities of the gymnasium and the athletic field.

B. The reëducation of muscular systems which have become weakened through disuse, paralysis or injury.

C. The development of the power of normal movements.

D. The restoration of function to disabled parts. (Nothing surpasses exercise in this respect.)

E. The improvement of neuromuscular coördination.

F. The increase of mobility (within safe limits).

G. The provision of opportunities for exercise which will not be injurious to the individual and which will be within his needs and capacity.

H. The training of the individual in "safe" exercises and games which can be used for years to come ("carry-over").

Although medicine and surgery can correct certain abnormalities, it remains in many cases for active exercise to restore functional efficiency. This is well demonstrated in the work with infantile paralysis cases; tendon operations are performed and improved movement and function made possible but something more is needed before the individual can actually USE the corrected limb. The need for active exercises was demonstrated in the physiotherapeutic work in the army during the World War. Men who had received the proper medical and surgical treatment for their injuries were confronted with a long period of inactivity and slow convalescence. With proper physiotherapeutic modalities and especially corrective and remedial exercises, the following results were noted:

1. The time of disability was definitely shortened.

2. Fully ninety per cent. were able to resume their former or allied occupations.

3. Many who would otherwise have been crippled and who possibly would have been burdens to their families and communities were returned to civil life fully independent.

The work of the Reconstruction Department of the United States Army was started in 1918 by Dr. J. Goldthwait and Dr. E. G. Brackett. Special Orthopædic Departments were installed in the United States and in France and England. Here physiotherapy in its various forms was used to build up the soldiers who had been injured in battle, and also to correct defects and relieve disabilities which became evident after the new soldiers had had a few long marches or had been subjected to unaccustomed exercise. The results of the work of the reconstruction department were very satisfactory in about ninety per cent. of the cases. Since the close of the war a number of the leading universities, including the University of Illinois, have organized departments of corrective and remedial physical education to take care of the large number of defective students who would otherwise be neglected in the physical education program.

The work with the subnormal and defective individuals, as carried on by the leading universities, varies according to the needs and capacity of the individual. It may be preventive, corrective, remedial or protective in nature. The aims are:

A. To prevent abnormalities by providing practice in health habits.

B. To correct existing defects and organic disturbances which can be corrected by physical measures such as diet, rest or exercise.

C. To protect against further injury or deformity in certain incurable cases such as organic heart lesions.

D. To maintain restored bodily function and organic vigor.

The idea that the body must be heir to various and sundry ills and disturbances is no longer accepted by intelligent individuals. It is not nature's plan that the individual should be in poor health. Nature designs health, and is successful unless there are conditions impossible for her to overcome. The task of preventive, corrective and remedial physical education is to assist nature in preventing interferences with natural function and to remove existing interferences, where possible.

To realize this goal, preventive, corrective, and remedial physical education gives instruction and practice in proper health habits, prevention of minor ailments, hygiene, rest, etc. It further stresses the need of periodic health examinations to acquaint the individual with his true condition. The work with organic disturbances such as kidney conditions, constipation and heart disturbances further assists in raising the health level of those who most need physical education.

Another step is taken in preventive, corrective, and remedial physical education when the individual is trained to obey the rules of health which will KEEP him in good condition, after his defect or disturbance has been relieved. The prevention of further deformity is stressed in work with those whose condition is not amenable to cure, as, for example, organic heart lesions. Thus the causes of the defect or disturbance are attacked and their further influence removed. The body is made to develop, as far as possible, an immunity to ill-health and bodily defects, by developing organic tone and vigor.

Corrective work is often spoken of as "Orthopædic Gymnastics." From the derivation of "Orthopædics" ("orthos" meaning "right" and "paidos" meaning "child") one naturally limits this work to "making the child right," or in other words "correction of deformities in children." Rightfully this work should be made universal for children and consequently abolish any need for it in adolescent and adult life. In actual practice to-day, however, the work is carried on with both children and adults.

The term "Preventive Physical Education" is used to describe the work

done with individuals who have faulty health habits and slight functional disturbances which if not corrected may result in definite structural or organic conditions. This phase is more generally understood—but is not always practiced.

The term "Corrective Physical Education" is used to describe the work done with individuals who have structural deformities such as weak feet, poor body mechanics, bone or muscle injuries, etc.

The term "Remedial Physical Education" is used to describe the work done with individuals who have organic disturbances such as heart disturbances, kidney conditions, constipation, etc.

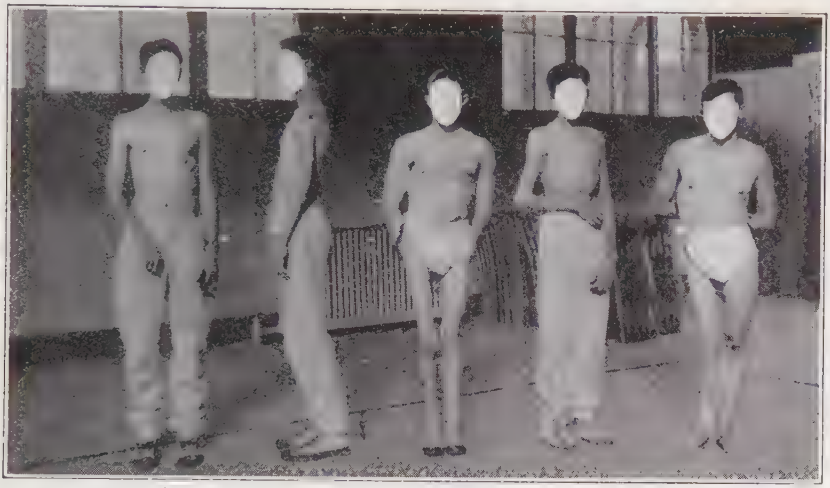
The terms naturally overlap. Preventive work is the natural outgrowth of the attempts to ward off defects and disturbances, which if not taken care of usually need corrective or remedial work. The terms corrective and remedial are in most cases united and the work is spoken of as "Corrective and Remedial Physical Education."

Make-up of an Average "Corrective Class"

Owing to the fact that our educational theory does not always alter existing practice, the average child of to-day is not given sufficient attention in matters of health and physique. This work is usually reserved for the colleges and universities. The aims in these higher institutions are to prevent or to correct deformities, to bring the various parts of the body into proper adjustment and to promote normal, or nearly normal, bodily and organic function. The work is no longer confined to flat feet and posture. All those individuals who do not fit into the regular athletic or gymnastic program are offered corrective and remedial physical education in proportion to their needs and capacities. Thus the average "corrective class" is seen to be made up of individuals presenting one or more of the following conditions:

1. Faulty body mechanics, including round shoulders and lateral curvatures of the spine. (The majority of the cases dealt with in the corrective department show the need for attention along posture lines. The faulty body mechanics is in many cases the result of an existing defect or disease, such as malnutrition, infantile paralysis, abnormal bone tissue, etc.)
2. Weak and flat feet.
3. Hernia.
4. Kidney conditions.
5. Heart conditions (functional and organic).
6. Malnutrition (undernourishment and overnourishment).
7. Paralysis.
8. Amputations and other permanent disabilities.
9. Weak joints and stiff joints (Ankylosis).

10. Pathological conditions following injuries or acute illness.
11. Nervous and digestive disturbances.
12. General debility and excessive fatigue.



A. B. C. D. E.

FIGURE 2

Types of Cases Found in College "Corrective" Classes

A. Albuminuria and atrophic right forearm.
B. Poor posture, underweight and atrophic left arm.
C. Infantile paralysis right leg.
D. Underweight, poor posture and atrophic right arm.
E. Infantile paralysis right leg.

A. B. C. D. E. F. G. H. I.

FIGURE 2-A

A. Funnel chest.
B. Scoliosis.
C. Underweight.
D. Flat feet.
E. Underweight.
F. Obese.
G. Underweight and atrophic left arm.
H. Defective left arm.
I. Heart lesion.

A. B. C. D. E. F. G. H. I.

FIGURE 2-B

A. Albuminuria and atrophic right arm.
B. Poor posture.
C Underweight.
D. Albuminuria and obesity.
E. Underweight and atrophic left arm.
F. Infantile paralysis right leg.
G. Underweight, poor posture and atrophic right arm.
H. Underweight.
I. Infantile paralysis right leg.

FIGURE 2-C

Right leg amputated below hip

FIGURE 2-D

Amputation of right hand and abdominal injury, due to Fourth of July celebration

A. B. C. D. E. F. G. H. I. J.

FIGURE 2-E

A. Knee injury and asthma.
B. Scoliosis.
C. Paralysis right arm and right leg.
D. Underweight.
E. Underweight.
F. Underweight.
G. Heart lesion.
H. Flat feet.
I. Heart lesion.
J. Underweight.

FIGURE 2-F

Atropic arms and underweight

FIGURE 2-G

"Wry neck" (Torticollis)

FIGURE 2-H

Same as Figure 2-G but with voluntary correction

The Need for "Individual" Work

In former years many of these defective individuals were excused from physical education. The majority of states now demand physical education in the school program and because of the large number of individuals who enter school with various physical deformities and defects it is necessary that the physical education program be extensive enough to take care of these individuals who need correction and control of their growth divergencies and handicaps.

FIGURE 2-1
Old Osteomyelitis

Individual attention is needed in physical education in order that each student may be given the type and dosage of work to fit his particular capacity and need. The keen coach knows that the individual of slight build and light muscles needs a type and amount of training different from that required by the heavier phlegmatic individual. The need is rarely the same in two people. Some doctors are criticized for their generalties in treatment: the army phrase of "Paint it with iodine and mark him duty" still rings in the ears of many. What would one think of a doctor who had as many patients to treat as the coach or physical educator has students, and who treated ALL with the same dosage of medicine? Yet in many cases physical educators are doing exactly this. There seems to be a fetish of symmetrical development which seeks standardized results in a quite unstandardized universe. In many cases little or no examination is given to determine the true condition of the individual who is to receive physical education. In other cases, even after an examination, all but the hopelessly defective are given the same type and dosage of work. Physical education is little better than common quackery when methods as decadent as these are offered to our students.

Physical education covers a broad field, and individuals differ in their mental and physical make-ups. Each individual should be graded and given physical education to fit his or her particular need. One should have no patience with "set" exercises for all members of a class of a certain age. This is not physical education; it is simply exercise and calls for the same objection that the late Walter Camp's "Daily Dozen" does. It may be better than nothing at all for SOME people, but too often it is done with

the body in poor posture and thus results in actual harm. For some individuals (*e.g.*, the over-active undernourished child) a bottle of pure milk and a walk in the fresh air and sunshine is what real physical education would prescribe.

Modern living demands a great deal of nervous energy, and rest is equally as important as activity. In some cases the prescriptions of definite rest periods for which regular physical education credits would be given would

FIGURE 2-J

Corrective case with two or three "normal" students for contrast

be supplying the real need of the individual. This rest period, for those having certain abnormal conditions or a very heavy schedule, could best be taken before and after meals and under supervision. As a rule it is better to prescribe easy walks in the sunshine than to compel a person to remain indoors when the weather is favorable. Stormy days, however, can well be used for rest periods. Many schools are providing cots and blankets for rest out-of-doors when the weather permits, and special rooms with windows open when the weather is bad. Physical education is, in its truest sense, the supplying of the physical need, and this may not always be physical exercise. It should provide work or rest according to the particular limitations of the

individual. It strongly advocates, for the better handling of studies, that the academic work be so controlled that an individual will not attempt more hours than he is physically able to carry.

With the awakened interest in health and physical activity has come the cry for "Back to Nature," "Outdoormindedness," etc. To quote Dr. J. F. Williams: "It should be remembered that the 'bookworm' who neglects his physical needs is to be condemned equally with the athlete who neglects his mental growth. This neglect of the physical in education not only deprives the youth of opportunity for wholesome growth, but by failure to teach habits of exercise in purposive play and games it lays the foundation for further physical deterioration in adult life through inability to use and enjoy the physical means of recreation." [1]

It is not to be denied that purposive play and games are conducive to better health. Unfortunately, however, we find in the average group of students a large majority of subnormal and defective individuals who cannot use and enjoy play and games as a means of recreation, or as a means of gaining health. We must start where the individual is NOW, rather than attempt a program made with reference to the individual at a point where he OUGHT TO BE. Preventive, corrective, and remedial physical education has the task of developing the majority of these subnormal individuals to a point where they will have the necessary vitality to participate in wholesome play and games.

If the aim of physical education is to raise, to the highest practical point, the level of efficiency or natural ability of the masses, the individual defects must first be given attention. An individual program must be organized which will better fit the defective for a more robust life. Health habits must be taught, and practice in these habits must be urged. Effort must be used to offset the present habit of heavy mental expenditure and slight physical expenditure. Organic vigor must be emphasized. It is not too much to expect that with a group of better developed individuals a properly organized play activity program can promote more favorable use of the entire body. This will maintain health. The individual must, however, be first made physically fit to engage in this play activity program.

Physiotherapy Following Athletic Injuries

Following athletic injuries the return to normal function of the injured part is greatly augmented by properly applied corrective and remedial physical education, as well as the other modalities of physiotherapeutics. After an operation on a semilunar cartilage of the knee or after the knitting of a broken bone, the physical educator with a knowledge of physiotherapy can aid in the restoration of normal function of the injured part. Surgical

[1] Williams, J. F., *Personal Hygiene Applied,* p. 26 (2nd Ed.), Saunders Co.

treatment often ceases with the relief of the acute symptoms and it should be followed with measures which will aim to restore normal function to the damaged part. If this restoration of function is not attempted, serious limitations often result. It should be the moral obligation, at least, for the coach or physical educator to do his share in the restoration of function in his athletic injury cases. From a more selfish point of view the coach should be interested in restoring proper function to the disabled part in order to shorten the period of disability of the player. The period of disability is often in proportion to the type and amount of after-treatment as well as to the proper treatment of the injury immediately following the accident.

It is urged that every coach and physical educator keep in touch with the doctors and join forces for the better treatment of the subnormal and injured individuals. No corrective and remedial education should be attempted without the guidance of a good physician who will determine the type of disability and the seriousness of the condition and who will assist in formulating the proper physical modalities which are necessary in each case. This guidance of the physician is especially necessary in organic disturbances of the body, such as heart conditions, and in cases of structural scoliosis, paralysis, etc. In many cases medication is needed along with physiotherapeutic measures. The joining of the forces of medicine and surgery with physical education can do much to alleviate the present condition of physical defectiveness.

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CHAPTER II

THE PEDAGOGY OF PREVENTIVE, CORRECTIVE, AND REMEDIAL PHYSICAL EDUCATION

The awakened interest in health and physical education has caused many physical educators and coaches to investigate the possibilities of adding preventive, corrective, and remedial work to their physical education programs. They are, at first, very likely to overlook the facts that subnormal individuals differ from the normal and that the methods of teaching which are productive of good results with the normal are not necessarily conducive to success in work with the physically defective. A knowledge of "sets of exercises" for certain abnormal conditions is not enough to guarantee even favorable results in work with the subnormal individual, although these sets are helpful in starting corrective work.

The medical profession has been of inestimable value to workers in this field. Doctor C. L. Lowman, an orthopædic surgeon of Los Angeles, in a paper read before the Therapeutic Section at the American Physical Education Association Convention at Oakland, California, July 23, 1921, spoke on "The Gymnast in Medical and Surgical Practice." In this paper Dr. Lowman outlined his requisites for success in teaching corrective and remedial gymnastics, and explained very clearly the technique needed in working with the subnormal individual. The majority of the successful programs of corrective and remedial physical education embody many or all of the principles laid down by Dr. Lowman at that convention.

Owing to the number of untrained men and women who have posed as physical educators, the science of physical education may have fallen somewhat in the estimate of the medical profession. The medical diploma scandal, which endangered the health of thousands of individuals and caused some anxiety on the part of the medical profession, shows that professions which are worth while are very often imposed upon by charlatans and quacks. The chaff is gradually being separated from the wheat. With this separation has come a spirit of coöperation among physicians and physical educators, as the following personal incident will show. After organizing an ideal program of corrective and remedial physical education for the University of Illinois, the writer submitted to Dr. Lowman a tentative outline of this proposed program. A six-page, single-spaced, typewritten letter of the most con-

structive criticisms was the answer from this busy orthopædic surgeon. And this case is typical of other orthopædic surgeons who have showed willingness to assist physical educators in their work with the physically defective.

PEDAGOGICAL PRINCIPLES

The following principles of pedagogy of corrective and remedial work are based on some of the principles laid down by Dr. Lowman and others, and on the writer's personal experience in corrective and remedial work.

1. Technical Training

A thorough technical training in physical education is necessary if one is to treat properly the physically defective individual. To the usual complete technical knowledge of normal physical activity must be added the further knowledge of abnormal physical activity, organic disturbances, etc., which are amenable to relief or cure by physical therapeutics. Practical knowledge may be gained by assisting an orthopædic surgeon in orthopædic gymnastics, and also by working with minor postural defects and cases of weak feet. Only by means of this practical experience under medical guidance can one realize the possibilities as well as the limitations of corrective and remedial physical education.

The kinesiology as taught in the better schools of physical education will be found of special help in the work with muscular conditions in the subnormal individual. The knowledge of movement of muscles is often the key to that very difficult task of "teaching localization of effort." Many weak abdomens and hollow backs present a shortened psoas group. The psoas muscles flex the thigh, and they also assist in extending the spine. Thus leg movements which may develop the weak abdominal muscles may at the same time be causing a further shortening of the psoas group.

It is commonly taught that exercise may be given on the basic theory that "function makes structure." *In certain cases of malnutrition there is already an overindulgence of physical activity.* A thorough knowledge of malnutrition will often demonstrate the advisability of diminishing the amount of exercise which the undernourished child is accustomed to take.

As one of the effects of exercise is to increase the circulation, caution must be used in work with heart cases. In heart lesions one must know something about "compensation." The question of how much exercise is to be given the heart case is determined by the type of lesion and the point of exercise tolerance. In many of the so-called normal activities the point of exercise tolerance is never given a thought. In working with heart cases an understanding of the circulation must be complete.

More of these general principles will be given with the more specific discussion of definite conditions which are treated in preventive, corrective and remedial physical education.

2. The Application of the Principles of Educational Psychology

In order that a child may learn to write correctly, educational psychologists have analyzed the various steps necessary in the performance of writing. In teaching corrective and remedial physical education the pupil must be taught how he can most profitably perform the various exercises, just as the pupil should be taught how to study. The absence of value in unthinking repetition has been justly stressed by Dr. Dewey. In corrective work the mere spending of a certain amount of time in performing exercises is relatively unimportant. The main fact is not how much—but how!

One of the objectives of corrective work must be the teaching of self-reliance. The teacher of this work should understand that results are determined only by the way in which the pupil is able to carry-on when left to his own resources. Instruction must be given in the "How" and "Why" of the work, in order that the pupil may get the greatest good from the procedure. Instruction should include details of proper health habits of a general as well as a specific nature. The desire to PRACTICE these health habits when away from the gymnasium, as well as while in attendance at the gymnasium, must be aroused, and opportunities provided for such practice.

Before any work is given, it is best to "talk over" with the student the reason why his condition exists and the means whereby he can correct or at least prevent further aggravation of the existing condition. Aimless routine work of the "One, two, three, four" type is not productive of lasting results. It makes satisfactory puppets, but not intelligent self-reliant individuals. There must be the clear understanding on the part of the pupil that the condition being treated is the *pupil's* condition and the results will be determined by the energy and zeal which *he* puts into the exercises. The pupil must be impressed with the fact that any shirking is not cheating the teacher, but is cheating the cheater. The teacher is a "Big Brother" and not a spy.

To give the reader an idea of the manner in which this work actually develops, a few extracts from the introduction of a student's letter will be quoted. (The department prescribes a certain number of exercises to meet the individual's needs and capacity, and after two-thirds of a semester has elapsed, the pupil is required to make out a series of exercises for his own condition and explain why he has chosen these particular exercises. If he wishes, he may give his reaction to the work, as this student did after two years in the department.)

"It was very embarrassing at first to be viewed by others as 'one-lungs, limps or what not,' because of our defects. We soon became accustomed to their critical gaze, and with the belief that this sort of training was beneficial, the exercising became tolerable—I saw no change in my condition after the first two semesters, but the Health Service thought differently and pronounced me cured of my trouble (Albuminuria). I managed to remain in the course because of a spine injury I had received during the summer months, and this defect was benefited noticeably. We can readily see that no miraculous results can be expected from a course of this nature: our internal and external bodily defects have been arriving at their present condition during years and years, and it is therefore obvious that they will not be cured in a few months. A slow process of rebuilding the body muscles must be done through the medium of various groups of exercises, each group having a specific function. The exercises are utterly useless if we do not go through them in the right spirit. If they are performed in a discontented, half-hearted sort of way, the results will be unsatisfactory and the good of the exercises will be lost entirely. The benefit derived is wholly in the hands of the student; it rests in his ability to dispatch each exercise to the best of his ability, with the thought that it will do him some good."

The Right Appeal Must Be Used to Secure Results. An appeal to action through the remote benefits of better health in adult life will not, as a rule, awaken response in the adolescent whose outlook on life may probably not extend beyond a few years. Propædeutic appeals are acceptable in a few cases with rich foresight, but the big appeal should be on immediate, rather than on remote benefits. A study of each individual and a knowledge of human nature is necessary to determine what appeal will best meet the condition at hand.

An appeal must be used which will arouse the pupil's interest in self-improvement, and this appeal is most successful when made indirectly. The better physiques which follow intensive work in preventive, corrective and remedial physical education will be valuable for making the school team, or for standing out before the other fellow, or for finding greater favor with the opposite sex. These objectives make a greater appeal than the plea of health for health's sake. The adolescent is interested in the joy which he can reap from the present and not in the possible pleasure of a richer and fuller life at fifty years of age.

Then an attempt is made to give the pupil a broad understanding of the reasons for his present condition. The sources of the condition are explained to him, with the aim of producing health responses which will destroy the

possible sources or causes of defects and ill-health. He must then habitually respond so that he will maintain an immunity to further disturbances along the line of his present condition. Emphasis is laid on the necessity for maintaining good bodily vigor and careful practice in ordinary hygienic habits. *The need for religiously practicing good hygiene outside of class as well as during class is constantly stressed.*

The student's desire to have a conscious part and a personal interest in what he is doing should not be overlooked. It is for this reason that he is given an opportunity to make out exercises for his own condition. These exercises are carefully considered, and the good and bad points are discussed with the student. Any failure on the part of the student to understand why he should or should not do a certain exercise in a certain way is fully explained. The idea of boresome routine physical training is removed from the mind of the student. He becomes more familiar with his condition, what caused it, how it can be corrected or relieved, and how he can prevent a recurrence by maintaining correction once it has been secured. Thus he is given a task, freedom to work it out, and enough guidance to insure good organization in the process.

During rest periods following the heavier exercises short lectures are given on common health habits which must be followed if one is to maintain a high health standard. An attempt is made to give to the student some information which will be useful for present-day circumstances. Facts pertaining to the prevention of "colds" are given immediately prior to the season which shows the highest percentage of absences from class due to colds. Preceding final examinations a short talk will be given on the necessity for keeping in good physical condition through sufficient sleep, adequate exercise, rest and diet.

3. The Desire to Help Others

In coaching athletics the newspaper publicity keeps the coach before the public. He is known as an important factor in the social life of the community—or if he has a "lean" year unkind things are often said about him. But the physical educator enjoys or suffers from no such publicity. Teaching boys and girls to walk and stand correctly, to use their bodies correctly, to form good health habits, etc., does not furnish very good material for large block newspaper headlines. *The teacher, however, who is sincerely interested in seeing pupils improve in health and physique under proper guidance is not worried about the lack of newspaper publicity attached to his task.* He finishes each day with a sense of keen satisfaction because of the realization that he has accomplished some worthwhile work and has done his part, small though it may seem, in helping individuals to live a happier and healthier life. It becomes his hobby to devise ways and means

to better the health of his pupils and the community. He is as interested in his preventive, corrective and remedial work as the most ardent student of botany is interested in the study of flowers. The joy of accomplishment of worthwhile and lasting things is his greatest reward.

Many coaches feel that their programs are too heavy to allow them to give any time to work with the defective individual. They have their teams to coach generally a group already in good physical condition. They have their academic classes to teach. Because his predecessor did not care for this group and because the school board has not definitely made the care of this group a part of his work, he is content to allow this opportunity for worthy service to pass by. It is well to realize that *a man is usually rewarded in proportion to the effort and industry he shows.* A careful analysis of the situation will reveal many minutes wasted by the average coach between classes and after the regular day's work is over. This time could be spent in taking care of a number of subnormal individuals. Also, a service can be done along this line by organizing adult classes for evening work. These older people can be given individual exercises for their various defects and conditions of ill-health. There is always plenty of material with which to work. Another means of awakening interest in corrective work is to hold body mechanics classes, after the regular school hours if necessary, for short periods of instruction in correct body mechanics. In the majority of cases where some corrective work is not done, the fault lies with the physical educator in not organizing these special classes.

4. To Teach Health the Teacher Must be Healthy

Health Is Contagious. The teacher who takes good care of his own body is generally rewarded by good health. *The health of the teacher creates confidence in the pupil.* Many teachers of the regular academic subjects are poor specimens of health. Many coaches and physical educators have failed to apply the common health maxims to themselves. The belief in one's work and the faithful practicing of health habits makes for better teaching of any subject, better teaching of health subjects especially, and a better physical individual. With the facilities for exercise and recreation found in the average city there is no reason why teachers should be such poor specimens of health as many of them are.

The health education movement stresses, very strongly, the health of the teacher. It urges every teacher to check up on his health, to be in the best possible state of health, a living example of his profession. *Teaching health by precept only is a futile task.* He must exemplify the highest possible standard of health, as well as of character and education. He must constantly bear in mind that the influences of personal association of teacher with student can be made productive of better health standards for the pupil

only when the teacher himself is a good example of all that health and vitality portray. And the idea that health is portrayed by large muscles is a thing of the past. Physical education no longer aims to develop physical monstrosities. The health which is urged is the health which is determined by organic efficiency and reasonable physique.

5. A Pleasing Personality

Between the teacher of corrective work and the pupil there must be that sympathetic understanding which arouses within the pupil the desire to measure up to the standards and responsibilities which the teacher sets for him. The average corrective case will very quickly measure up to the responsibility which is given to him. Owing to the sensitive nature of many of the students in corrective work the teacher should be especially careful to avoid anything which might be interpreted as a patronizing personality. Personal association between teacher and pupil must be constantly maintained in order that the spirit of helpfulness and sympathetic understanding on the part of the teacher is always understood by the pupil. *The teacher is the "Big Brother" to the pupil.* In this manner the pupil feels that he can talk over his troubles with the teacher. Only with a thorough understanding between teacher and pupil may many of the points of doubt as to the "why" and "how" be carefully explained.

This type of teaching is a trifle more difficult than the iron rule type which is often seen in the gymnasium to-day. But it is surely more valuable because the best discipline comes from a thorough understanding between pupil and teacher. When the instructor's back is turned in the average gymnasium class or when he ceases to count—the show stops! But the average case in the corrective group will continue exercising when the teacher is NOT WATCHING just as well as when he is watching. *In corrective work the pupil is made to understand that his condition is remedied only by the work the pupil performs.* Any loafing in corrective work is simply a case of the loafer cheating himself.

A pleasing personality and a cheerful disposition soon break down the occasional antagonism of pupils who are required to take corrective work and who are not yet fully aware of the reasons for their doing so. The experienced teacher understands that this antagonism is the result of two things:

A. The pupil does not understand why he should take the work.
B. The pupil who is physically subnormal does not respond normally.

Trying to overcome this antagonism by brute strength is tiring to the teacher and productive of little in the way of successful and lasting results. The situation must be accepted in its true light. The pupil must be quietly

informed of the nature of the corrective work. (The value of the work is described in terms of the benefits to the pupil—not to the teacher.) He must be patiently encouraged until he gives normal responses. The student's letter from which extracts have been quoted shows clearly the spirit of the individual who failed to see any good in the work—at the start. He was surprised to find that his kidney condition had cleared; he began to realize that his condition was the result of years of neglect; he concluded that a miraculous cure in a few months was out of the question; he further realized that the good of the exercises depended upon his own efforts. Thus the cheerful personality of the teacher and his spirit or desire to help is soon conducive to the winning of the student to health's side.

Many coaches who are interested in helping the subnormal individual fail to secure good results in this work because they cannot realize that the individuals with whom they are working are not normal individuals. They give the weak, poorly coördinated individual work which is beyond his capacity. One important rule in working with corrective cases is that *the task must be so easy at first that the pupil will believe he can do it.* This assures the successful completion of the task. Continued failure is depressing; success is stimulating. Later the task may be made so difficult that it seems worth while. Thus the individual is introduced to the work and finds that he can accomplish the task. When he shows improvement, the work is made more severe and, due to his initial success, he attacks the more difficult work with a feeling of ability. He soon achieves additional success—and much needed strengthening of confidence in his ability.

The teacher must always appear as a helper to the student, rather than as the old-style "Overlord." The student soon recognizes the difference and measures up to his responsibility. He does his part well. The spirit of the "Big Brother" movement can not be too strongly stressed in the work with the physically defective individual. Students must be urged to question regarding certain exercises, how they can improve their health, etc. It is not unusual, following the dismissal of a corrective class, to see one or more students talking over their cases with the teacher. This spirit makes for real effort and success.

6. Patience

This virtue is especially needed in working with defective individuals. The observer who is looking for the accurate neuromuscular coördinations which may be found in a skilled gymnastic team is doomed to bitter disappointment when he observes a demonstration of corrective work. *There is a distinct lack of coördination in the majority of those who are taking corrective work.* Mentally they are normal, many are precocious, but when a motor response of even the large muscle groups (necessitating a simple

coördination of brain and muscle) is required, the performance is often done very poorly. In the corrective group there is an outstanding lack of fundamental development and neuromuscular coördination. Many have NEVER PLAYED. This is the group which, in the average high school, sits on the sidelines and WATCHES the performance of the athletes.

The untrained teacher may think that the pupils are not trying to do good work. In many ways they are like the small boy learning to write, who uses his entire body—often at cross purposes. To scold this type of pupil only makes the situation less tolerable for all concerned. Neuromuscular coördinations must be patiently developed. Repetition and more repetition will be needed before the individual performs his task well. Patient training and avoidance of harsh criticism is needed in this work. The pupil must be encouraged in his work. But he must also be carefully guarded against fatigue.

The sensitiveness of the physically defective student is often manifested in an inferiority complex. This must be met with a spirit of optimism, patience and enthusiasm on the part of the teacher which arouses in the mind of the pupil that hopeful attitude which will insure success and accomplishment. Many cases of an incurable nature such as organic heart lesions induce a "defeatist" attitude towards life. The victims are beset with doubts, problems and worries and the resultant gloom and depression. Great care must be exercised by the teacher to instill mental and physical courage into the pupils. The task here is to make these individuals self-reliant and also to prevent any aggravation of the existing condition. The spirit of "I can't" must be sublimated to the feeling of "I will."

Although the writer realizes that he will be criticized for mentioning "selling the idea," the fact remains that the goal of health and physical well-being must be constantly "sold" to the subnormal pupils. *The benefits to those who are taking the work must be constantly and patiently reiterated.* Logical aims, supported by reasonable facts and devoid of extravagant claims, will develop in the pupil the desire for better health. A patient, cheerful teacher will very quickly change the pessimistic attitude of a student to one of hope and desire for better health and to that ever-necessary attitude of "I will."

7. Mental Alertness

Owing to rapidity of development of the Health Education movement and the rapid unfolding of possibilities in preventive, corrective, and remedial physical education, *it is necessary for the teacher of this work to keep abreast continually of the recent developments.* He may accomplish this by reading along the lines of health education, corrective and remedial physical education

and orthopædics. The literature of physiology, psychology, preventive medicine, orthopædics, etc., contains many suggestions which will be found useful in work with the subnormal group. A knowledge of what is being done in fields closely allied to physical education will often show the physical educator that his own field has its limitations and may prevent the dangerous error of thinking that physical education is a panacea for all ills.

The more one studies physical therapeutics the more one realizes that proper technique is needed for successful results. The "half-baked physical educator," the college athlete who has little or no knowledge of physical education beyond his chosen sport, the "bare-torso kings" and the ex-pugilists have done a great deal to hurt the physical education profession. They have rushed in where better informed doctors and educators have feared to tread. And because they have had some good results in some cases, in spite of their crude methods, they have proclaimed to the world their method as a cure-all. They discover, in a few cases, that a "raw-food" diet literally "picked an incurable invalid out of his sick-bed." Thus the raw food diet is advocated for every one. Another group of faddists finds that meat is the cause of our poor health and meat is banished from the diet. The careful scientist weighs the evidence and proves his case from all angles while the bungling "health enthusiast" jumps at conclusions with little or no proof to substantiate his claims. Physical educators can and must avoid these pitfalls by careful study.

The mentally alert physical educator is familiar with the works of the scientists. He recognizes his own limitations and the limitations of his field. He seeks for proper technique and he refuses to become over-enthusiastic without sufficient proof of the worthiness of the proposed cure. This is the attitude which should be cultivated by the physical educator who really desires to help in the great work of raising the health standard of the masses. Keeping in touch with the up-to-date (but not over-enthusiastic doctors) will aid one in his work with the physically subnormal.

8. Sincerity

The physical educator who is working with the subnormal group will find his students responsive and interested in their own welfare if the teacher is sincere in his work and obeys the health laws which he lays down for his students. One example of this fact may be seen in the matter of wearing of proper shoes. It is useless to lecture to the student on the dangers of wearing incorrect shoes when the teacher fails to clothe his own feet properly. The obese instructor secures little response from his obese students when he lectures on the necessity for proper balance between nourishment taken in and energy expended. *The teacher must practice what he preaches.*

9. Knowledge of Pupil's Habits, Living Conditions, School Program, etc.

A thorough knowledge of the "personal history" of each case is necessary before one prescribes a program of physical activity for a student. The child who is carrying a heavy schedule, who has a number of duties to do around the home, and who possibly walks a good distance to school, should naturally be given a lighter program of physical activity than the boy whose daily habits are devoid of home duties, long walks, etc. The postponement of a child's retiring hour on account of the social activities of the parents, and the attendant excitement should be considered. Irregular hours and too great and too constant stimulation from grown people use up so much nervous energy that the high-strung child often has no reserve strength. The child whose parents insist that he practice music during the time when he might be out-of-doors and engaging in play, presents a different problem from the child who is carefree after school hours. The child whose fond parents insist that he study during the summer months, in an attempt to catch up with the other children in his class, has an obvious difficulty to overcome in securing health. All these conditions present problems in arranging a program of individual preventive, corrective and remedial work.

Failure to take cognizance of the above condition will often overburden a child who is already carrying a peak load. *Some adjustment must be made to allow the child's health to be considered as well as his academic or social advancement.* Parents who have little leisure or little training cannot be asked to give the same careful attention to the child's performance of home exercises as the parents who labor less and know more of true health conditions. It is found in many cases, however, that the busiest housewife finds time to attend to her child's exercises while the "social climber" is too busy with her bridge parties, club work, etc., to give the necessary care and attention to the health of her child. When she finally realizes the importance, it is sometimes too late. It is needless to say that the same criticism can be given in the cases of many neglectful fathers. Tact is necessary in dealing with these cases which present conditions somewhat out of the ordinary.

10. Vision

In its narrowest sense vision means the power to visualize the individual in an improved or cured condition. This is necessary in order that the teacher may have a definite objective toward which to work. In its broader sense vision means the knowledge and application of the various factors in the health education movement and especially the promulgating of physical education measures on an extensive scale. Thus the health of the entire community can be bettered by the physical educator's support and leadership in the Health Education movement. The task of improving the health of the

youth of to-day must be considered as the training and education in health matters of the men and women of the future. It is time that the physical educator realized the tremendous influence he has with the youth of to-day. It is something far more important than winning a few games; it is valuable in training for life. *An extensive program of health education can do much to teach the child health habits and "carry-over games" which will be of inestimable value in maintaining health during adult life.* When physical educators work as a unit for the health interests of the nation, there should be a marked lowering in the number of defective school children. It is estimated that seventy-five per cent. of the school children in the United States are defective in one or more particulars. Here is surely a situation crying for a remedy.

In this age of hurry and hustle the acquiring of money seems more important to many individuals than the reasonable care of their health. They are developing their minds at the expense of their bodies, thus passing down to their children bodies which are not capable of meeting the demands of modern civilization. The average so-called "intelligent" people of to-day are not rearing children in large numbers. The parents of these children, and the children themselves, are soft. The child is born into an environment which is not conducive to robust physical development. Many of the children are undernourished, not from lack of money with which to buy the right kind of food, but because of too much food of the wrong sort. Too many social engagements, late hours and lack of exercise also undermine the health of the child.

Although the son of soft, poorly developed parents may not be one who will bring joy to the football coach, physical education must do its part in giving this weak, badly nourished child as good a physical development as possible. Three reasons present themselves at once:

First, because physical educators recognize a moral obligation to their profession;

Secondly, because the boy must not be permitted to suffer for the ignorance of the parents:

And thirdly, because through the child the parents may be made to see the error of their ways and conform to proper health habits. To claim a place as worthy health agents, physical educators should have enough civic pride in their work to seek out the idle spectator and sedentary individual and provide suitable places for them in the physical education program. Then this needy group may be made into men and women who will be assets to the community. *The test of a real physical educator is not that of teaching those who are already interested in physical education, but rather that of developing attitudes, desires and interests in those who are not interested in physical education.*

Another phase of vision has been developed in the work with defective individuals. This is the "peripheral vision" which enables the trained teacher to give apparently his undivided attention to one individual in the group and yet see all the other individuals and be fully aware of the performance of each one. When the boy with weak feet relaxes his attention on his parallel foot position, the instructor immediately sees him do so. He quietly calls attention to the incorrect foot position though he may ostensibly be working with another boy ten paces away. This habit comes only with experience and practice in teaching but finally seems almost instinctive. One instructor said that he "felt that something was wrong" when any one in his class assumed a faulty position.

11. Optimism and Enthusiasm

The individual who resents being placed in the corrective department finds it very difficult to maintain his grouch in the face of an optimistic and enthusiastic instructor. In dealing with incurable conditions this optimistic spirit is of great help. *Many individuals are greatly benefited as soon as they catch the spirit of enthusiasm and optimism which the teacher radiates.* The student is promised nothing impossible, but he is quietly made to realize that, in incurable cases especially, there is little use of his grouching over existing conditions, or "crying over spilled milk." It is not a difficult task to show the complaining individual that he is not as badly afflicted as are some others. A recent incident shows how this works out. One boy whom infantile paralysis had left with a badly withered leg lamented the fact that he had to take corrective work, "nothing could be done for him," etc. The writer quietly suggested that he look over the group which were then engaged in doing corrective exercises. In this group was a boy with both legs paralyzed much worse than the one leg of the complainer. The chap with two withered legs had a smile on his face and seemed quite content with what was being done for him. It did not take the newcomer long to draw his own conclusions and stop complaining.

Heart cases are the worst offenders in the matter of grouching. They have been repeatedly informed by well-meaning individuals that their cases were hopeless. It takes a great amount of explaining and encouraging to show these victims that, though their heart lesions are incurable, they can improve the organic efficiency of their bodies and that by this improved condition of their respiratory systems, metabolic processes, skeletal systems, eliminating organs, etc., they relieve their hearts of a great amount of work and in the end are physically better for having exercised. The story is sometimes told them of the elderly lady who had but two teeth, and yet each morning and night she thanked God that these two teeth met.

12. Equipment

The first athletic fields in this country were not very elaborately equipped. The main thing was a space in which to play. The corrective worker can learn much from the above example. *The keynote of the corrective department should be simplicity.* A room in which to work is the first requirement. Beyond this there should be a few stools and stall bars, a narrow treatment table, one or two sets of pulley weights, a few light wands, Indian clubs, dumb bells, a thermolite and a three-piece mirror. These comprise the practical necessities for starting corrective work. In too many instances the teacher asks for elaborate and costly apparatus which is not absolutely necessary at the beginning. The natural reaction to such a procedure is the demand for elaborate and often miraculous results. Better success can be secured at the start with simple equipment and plenty of zeal for the work than by elaborate apparatus to mystify the gullible.

Another objection to elaborate apparatus is that it creates an environment which does not make for self-reliance. The object should be to train the pupils in exercise habits which can be done outside the gymnasium, rather than to train for demonstration purposes in the gymnasium. Given elaborate apparatus in the gymnasium there is a conditioned response to the elaborate apparatus. At home where the elaborate apparatus is not found, there is something missing. The pupil does not feel that he is working under that exercise environment of the gymnasium. When a pupil can easily perform at home the work which he has been trained to perform in the gymnasium, there is greater likelihood of the "carry-over" which should be one of the big objectives in physical education.

The objection to elaborate apparatus is especially true where corrective work is first started in a school. The authorities are reluctant to spend a great deal of money on this "experiment." Very little time can be given to this work at the start. The logical thing to do, then, is thoroughly to instruct the pupil in the fundamental movements which are to be done outside of the gymnasium. For this work a "home work" card is often provided on which is recorded the exercises to be done, number of times which each must be executed, number of hours of sleep, bowel action, reaction to exercise, etc. A successful start has been made in a number of schools by setting aside a free hour once each week and inviting parents to come with their physically subnormal children. At these corrective clinics the children are given their exercises and the parents are instructed in the home work connected with this procedure.

Supplementing the equipment noted above, various posters may be used. These posters should picture concrete examples in the language which the pupil can understand. The Children's Bureau, United States Department of

Labor, Washington, D. C., has published a set of six posture standards which can be purchased for fifty cents. These posters show the excellent, good, poor and bad postures of both boys and girls, and tell just what is wrong with the poor postures. See pp. 73-78. Their purpose is to create in the mind of the pupil the desire for health and the realization that health, happiness and efficiency are the results of good health habits properly followed. The department of drawing will, in the majority of cases, coöperate with the corrective department in making posters dealing with diet, proper footgear, proper walking, proper posture, etc. These "home-made" posters are especially recommended because, as the products of the school, they excite more personal interest. Often the defective pupil himself learns a lesson never to be forgotten by making a poster to illustrate some health law.

The costume of the teacher should be spotless white. The usual attire is white gymnasium shoes, white trousers, and a white tennis shirt with a black bow tie. For the teacher of the girls' corrective work white bloomers, white middy, black tie and white shoes and stockings are recommended. The white attire of the teacher creates a good psychological effect on the pupil; it carries over a feeling for cleanliness and a certain dignity.

The costume of the men and boys should be white running pants, white jerseys, short white woolen hose and white shoes. In cooler weather clean white "sweat" outfits should be permitted for they are found very satisfactory in working with heart cases, kidney conditions, paralysis, etc., where chilling and exposure must be avoided. Added care must be given to see that these "sweat" outfits are kept clean. In foot classes the students report with well-fitting basketball shoes and white stockings. The actual exercises for foot cases are performed without shoes.

TEACHING PREVENTIVE, CORRECTIVE, AND REMEDIAL PHYSICAL EDUCATION

In many schools where this work has not been previously organized, it is necessary to make a simple beginning. This can be done by taking only the groups with slight defects which can be easily and quickly benefited. For example, weak feet, slight postural disturbances, slight underweight, etc., cases are amenable to quick correction by special exercises. Although this could not be interpreted as an ideal program for corrective work, it will take care of the "slight" cases and prevent these cases from further deterioration. This type of work is known as "Group Corrective" work and is often a forerunner to the more specialized type which is known as "Individual Corrective" work. The good results which are secured with these cases often cause the school authorities and the community to provide further means whereby the teacher can extend his or her work to include those who are more in need

of individual corrective and remedial work. The following classification is offered as a practical scheme which will enable the physical educator to provide physical education as it best fits the individual's needs and capacity.

A. The Elementary School

Regular. Those without defects, deformities or diseases. These students are able to engage in the ordinary program of gymnastics and athletic work.

Group Corrective. Those with slight conditions such as: poor posture, weak feet, slight functional heart conditions, constipation, obese and slight underweight; or those who have just returned to school following a debilitating illness, etc. These pupils remain in the corrective class until their condition improves sufficiently to allow them to engage in the regular work again.

Individual Corrective and Remedial. Those who need personal attention. This would include those who have very bad posture, organic heart lesions, marked foot weakness and flat feet, infantile paralysis (and other cripples), hernia, pathological conditions following acute illness, neurasthenia, marked underweight, etc. This last group should be taught in small classes of from eight to ten in a group. Each is given his individual exercises for his particular condition. Instruction is given on the basis that the work is to be practiced at home. For best results the parents are asked to attend so that their coöperation is secured.

B. Junior and Senior High Schools

Regular. Same as for elementary school.

Group Corrective. Same as for elementary school group with the addition of albuminuria cases. Very little difficulty is encountered in working with this group if the teacher classifies the members into smaller groups, *e.g.*, a posture group, a weak feet group, etc. The aim in working with the group corrective type is to fit the individuals so that they may return to the normal group with their defects corrected and with a thorough understanding of how to avoid a recurrence of these defects.

Individual Corrective and Remedial. Same as for elementary, but with the following additions: thyroid cases, those with injured limbs, arrested tuberculosis and other types of ill-health which require individual attention and protection from further injury.

Nutrition Group. Because of the large number of undernourished children in the schools to-day some provision should be made to correct this condition. With the coöperation of the Home Economics Department a great deal can be done in teaching food values from the health standpoint. These students should be educated in correct eating and also be given suitable physical activity without causing over-activity. In many cases rest is given

in place of physical exercise. Owing to the incessant activity of many of these undernourished individuals the major part of the physical education work, at the start, may be taken care of by the next division (Rest Group).

Rest Group. Post-operative cases, tuberculosis suspects, undernourished, nervous, etc. For these, rest is provided during the regular physical education hour and is supervised in order that absolute rest is secured.

Where the organization is elastic enough, it is well to provide for a special "recreation group." In this group, work is done with two types of individuals:

1. Those who must be restricted in their activity due to recent illness, slight hernias, slight functional heart cases, etc.
2. Those who have been in corrective work for some time and whose conditions have been relieved but who do not coördinate in game activity. In many cases they have never played. This group should be taught HOW to play so that they can enter into the games with the other children without that feeling of "not belonging" or "spoiling" the game.

It must be understood that the above plan is not the last word in what might be done for those needing preventive, corrective, and remedial work. It is only an attempt to offer the practical side and avoid the theoretical. A successful start is a good beginning in corrective work. The above outline WORKS. Of course the group work is not so satisfactory as the individual work. However, when differentiation is so made within the group that it is broken up into smaller units a big step has been taken toward providing the individual with work which is more nearly suited to his particular condition.

In university work this grouping is necessary because of the large numbers who must take corrective work. The group is divided into various sections as outlined above, and one other section is composed of students who need individual attention. This last section is made up of scoliosis cases, cripples, arrested tuberculosis cases, organic heart cases, etc., and those who do not fit into the various other groups. For example one boy is almost deaf, another boy has very poor eyesight, etc. With the group work for posture cases, weak feet, albuminuria, etc., over five hundred students are given corrective work five times each week. The results have been deemed worthy of additional space and of so much assistance that groups are gradually being made smaller and more individual work is being done.

An ideal, but often impractical situation is one instructor teaching one student. This cannot be followed as a routine procedure, but office conferences with individuals will often make it possible for a limited time. In a large corrective class there will be many students who need *individual work.* The larger the number in this unit the less time the instructor can give to

each student. Ten students are all that one instructor can conveniently handle for individual corrective work. The individual corrective work for these ten students is taught as follows:

The students are arranged on the floor in no set order. In front of each student is a special card on which is recorded the diagnosis of the student's condition and the prescription of exercises for him. Each exercise is numbered. The teaching procedure at the University of Illinois is as follows:

A. The first student is given his first exercise by the teacher, and he starts exercising without further delay.
   The second student is then given his first exercise, and he starts his work independent of the other students.
   The third student is given his exercise, and he commences his work.
   Thus the fourth student and on until the tenth student is given his first exercise.

B. The first man is now given his second exercise, and he starts exercising again.
   The second, third and on until the tenth man has started his second exercise.

C. The procedure is repeated for the third exercise and on until all the exercises have been given.

FIGURE 3

Corrective group—each doing his own individual exercises

FIGURE 3-A

Small group of correctives using a corner of the gymnasium

FIGURE 3-B

Corrective class—showing instructor taking weight of undernourished student
(Class work is not disturbed)

For the first few days the class performs rather poorly. Exercises must be explained each day, and progress is not rapid. The teacher is very busy teaching each student his various exercises. The secret of the success of this method lies in the fact that each student is told that HE must LEARN his exercises. (An examination is given on the exercises.) After the first few days the teacher calls the class together and gives the command, "Take your first exercise." Each student immediately starts his exercise. This leaves the teacher free to go about the class, encouraging those who are not performing well, commending those who are, and adding points of instruction so that each student gets the greatest amount of benefit from each exercise. There is no counting! Each individual performs "at will," or at his most efficient speed. Some work more slowly than others. One student may do his third exercise ten times and then rest until the command is given, "Take your fourth exercise," while another more robust individual does his third exercise until he is commanded to proceed to the fourth exercise.

The groups are handled according to almost the same procedure. The posture group is given its first exercise and it begins work. The functional heart group is given its first exercise and it starts to work. Thus each group is given its first exercise until all *groups* have been started. When the time for the second exercise is at hand, the procedure is repeated. For facility in learning the exercises in the group one student (preferably a good performer) in the posture group is told that HE is responsible for the first exercise, another is responsible for the second, and so on. In this manner it is not unusual on the second day for the teacher to give the command, "Take your first exercise" and, following the lead of the one in each group who is responsible for the first exercise, every one in the class starts working without delay. This method allows the instructor time to go among the class and give needed assistance. A keen eye is needed to see that each student in a given group is responding favorably to the work. In many cases it is necessary to change a certain individual's exercise; it will be made slightly easier or it will be made more difficult. In a few cases, owing to complicating circumstances, an entirely different exercise will be quietly substituted. In this way the work becomes almost individual, even though it is done in the group.

A quite similar scheme is used by some teachers of *individual* corrective work as follows:

With ten pupils in the class ALL are started at the same time with an exercise which will be beneficial to all and harmful to none, *e.g.*, a fundamental posture exercise such as lying on the back with the knees flexed and the feet resting flat on the floor. From this position the student draws in the abdomen and lowers the small of the back to the floor as the breath is expelled. This starts the class off as a unit. It is somewhat easier to administer than the individual work outlined above. The second exercise is given exactly as

described in the Illinois system. An added feature, in cases where ten exercises are given, is to make the fifth exercise the same for the entire class. This may also be a fundamental posture exercise. This method of teaching preserves the unity of the class and is very good. It is not too far-fetched to say that all in the group can be benefited by a few good posture exercises. The sixth exercise and on through the ninth are given as in the Illinois system. The tenth exercise is the same for all pupils. This may be a breathing exercise done in the fundamental standing position. The giving of the last exercise in the standing position is highly recommended for heart cases, as well as others, because it prepares the body for the next move which is leaving the class room. When the last exercise is done in the supine position, the dismissal bell often finds the student jumping to the erect position with a speed which is harmful in heart cases. In cases where corrective work is new, the above scheme is very much easier than the Illinois method.

It might seem to the uninitiated that the above methods are too cumbersome and difficult to handle. Whether they are or not depends largely on the teacher. He must be competent. He must have a complete knowledge of a good system of classified exercises, which are arranged by code numbers. To be sure it would be much easier to teach the entire class the same exercises than to differentiate and teach a great many separate exercises to the various individuals in the class. But individuals differ, and exercises should be adapted to the particular needs and capacities.

It must be understood that before any exercises are given, one period, or more if necessary, must be given over to explaining to the class the way the work is to be conducted, the reason for coöperation, the good which they will secure from the work, etc. This educational factor must not be overlooked when one evaluates the work done in the corrective department. The students, almost to the man, respond to the idea of helping themselves by coöperating with the teacher. They realize that they are in class for a purpose. When this purpose is the bettering of their own condition, the matter of discipline is the least of the instructor's worries.

RECORDS AND CLASSIFIED SYSTEM OF EXERCISES

The first record of importance is the examination record of the individual. This includes the various items of personal history usually noted in a complete examination, including the condition of the heart, lungs, glands, etc., and it should be carefully studied before any exercises are recommended. Space should be provided on this examination record for the physician to prescribe the *type* of physical education activity which is best suited to the individual's condition. In some cities provision for the physician's recommendation is made, as follows:

PHYSICIAN'S RECOMMENDATION TO THE
DEPARTMENT OF PHYSICAL EDUCATION.
(Card size, 4" x 6")

..........................School

To be mailed to M.............................. Director of

Physical Education, for Boys / Girls

This certifies that I have examined ....

.... and that, in my opinion, because of ....

................he/she can not safely take part in the activities which I have checked below:

Calisthenics Apparatus gymnastics Folk games
Individual athletics Athletic games

I recommend that exercises be given for the correction, or prevention of further aggravation, of the following underscored conditions:
Poor body mechanics, weak muscular system, weak feet, flat feet, underweight, overweight, functional heart condition, organic heart condition, hernia, kidney disturbance, eliminative disturbance, nervousness, injuries, or ________________________
(Note additional conditions)

I recommend complete rest during the physical education period.

(Underscore if recommended)
Signed .... M. D.
Date 19

FIGURE 4
Physician's Recommendation

The recommendation given above provides the physical educator with a basis on which to prescribe the best possible type of physical education for the individual's needs. He has first the examination card which gives him the necessary information regarding the individual's habits, previous illness or injuries, etc. Second, he has a complete record of the individual's physical condition as determined by the doctor's examination. Third, he has the doctor's recommendation (interpretation of diagnosis) as to what type of physical activity will be most likely to do the individual the most good. Such

a recommendation also eliminates the difficulty of "Excuses" from physical education work. No excuse should be granted unless the physical education program is unable to provide suitable training for the individual or unless a local physician is not available and cannot make proper recommendation for the case in question.

UNIVERSITY OF ILLINOIS—HEALTH SERVICE

It is recommended that M...

drop..and add..

Reason..

....

To

....M. D.

Date..

To the student: To change your registration in accordance with the above recommendation you must follow carefully *and at once* the directions given on the other side of this slip.

5M—11-26

FIGURE 4-A

Notice from Health Service to Department of Physical Education (front view)

DIRECTIONS TO BE FOLLOWED BY THE STUDENT:

1. Go at once to the Dean of your college, present this recommendation, and obtain a change slip.

2. If you are dropping military take the change slip to that department for signature. (Armory)

3. If you are adding or dropping courses in physical education take the change slip to that department for signature and assignment to a section. (Men's Gymnasium)

4. Return the change slip to the Dean of your college for his signature.

5. Deposit the change slip at the Recorder's window in the Registrar's Office, 156 Administration Building.

YOUR REGISTRATION REMAINS AS IT WAS ORIGINALLY APPROVED UNTIL YOU HAVE CARRIED OUT THE ABOVE INSTRUCTIONS IN FULL.

FIGURE 4-B

Notice from Health Service to Department of Physical Education (back view)

The next record of importance is the physical educator's record of the individual's case. This is taken in the following manner.

A. For Elementary School and High School (Card 4″ x 6″)

(Front of Card)

Corrective and Remedial Physical Education

Name Age Date School

Class hour Class days Date started .... dismissed....

Physician's diagnosis ....

....

....

Physician's recommendations (or remarks) ....

.. ..

....

℞ ....

....

....

....

....

Results.................. P. E. grade...............

Instructor's signature..............

Figure 5

Types of Cases Found in College "Corrective" Classes

(Back of Card) 4″ x 6″

EXAMINATION RECORD (ORTHOPÆDIC)

Date Date Date

Height

Weight

Nutrition

Head

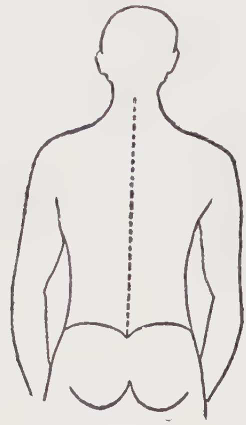
Kyphosis

Scapuli

Spine

Scoliosis

(Note whether functional or structural)



Chest

Abdomen

Lordosis

Hips

(Note pelvic position: pelvic tilt, pelvic twist)

Feet

Weight distribution

Posture rating ("A," "B," "C," or "D")

FIGURE 6

Outlines to be used in connection with Examination Record (Orthopædic)

The same type of card may be used for college work. Where finances permit, it is urged that a 4″ x 6″ buff colored lightweight cardboard envelope be used. See figures 7 and 7a.

Department of Corrective Gymnastics

Name ....

College .... Course .... Year ....

P. E. Course .... Hour .... Date ....

Diagnosis ....

....

....

℞ ....

....

....

....

....

....

....

....

....

FIGURE 7

Front View of College Corrective Envelope

Semester Results

1. ....
2. ....
3. ....
4. ....
5. ....
6. ....
7. ....
8. ....

Semester Grades

1	2	3	4	5	6	7	8

FIGURE 7-A

Back View of College Corrective Envelope

The use of the envelope system renders the record of the individual's condition and the prescription of exercises for him easily accessible. It has the further advantage that the physician's recommendation and any other notices (*e.g.*, excused absences, etc.), can be filed in one convenient folder. This system is further recommended because of the durability of the record. In teaching individual corrective and remedial work the cards must be handled more often than the records of those taking regular physical education. With the envelope system the roll is generally taken by placing the individual's card on a definite place on the floor and by having the individual stand behind the card. The teacher gives the exercises by glancing at the code numbers on the card. At the end of the class period the student hands his card to the teacher. Only the recording of the cards which are left on the floor is then needed for a complete record of the absentees.

Mention has been made of the use of code numbers in recording exercises. Thus a set of exercises might read as follows:

1. 35. 46. 5. 9. 25. 75. 32. 39. 4.

The teacher knows that exercise number "1" means that the student is lying on his back on the floor, hands at his sides, knees bent, heels resting flat on the floor and close to his buttocks. The action, or movement, of the exercise is known to consist of drawing in the abdomen and exhaling as the back is forced to the floor by the contraction of the buttocks muscles and the drawing in of the abdominal muscles. The student then relaxes, inhales, and repeats the exercise. All this is understood by the code number "1." The second exercise (number 35) means alternate knee flexing from the supine position. By the use of this method, the teacher learns by numbers enough exercises to meet the needs of the various types of cases which are amenable to relief or cure by corrective or remedial exercises.

On first thought it seems easier to jot down the description of each exercise. This method is easier at the start, but it delimits the user of it, for more time is required to note enough points of description of an exercise to enable the teacher to interpret the notations quickly. Much time can eventually be saved by so learning the numbers for each exercise that when teaching the exercises, a glance at the card and a number quickly flashes before the teacher's eyes a complete exercise movement. Fifty to seventy-five exercises are sufficient for a beginning as the same exercises may be used for different conditions. The writer does not claim originality in the use of this method. Dr. Crampton describes many exercises by names, such as the "Star Gazer," "Wrist Lift," etc. The late Dr. Sargent described many exercises by names. The use of the number saves time in writing and space on the card. For those who have never used the number or the naming of exercise methods it is suggested that one set of exercises now being used be

numbered from one to ten. When a new set of exercises are being made out, the first one in the new set can be numbered eleven, the second one numbered twelve, and so on. In this way a permanent record will soon be made of the most useful exercises.

Terms and Their Misinterpretations

The use of the term "corrective exercises" is somewhat unfortunate. Every possible effort must be made to remove the feeling among a special group of students that they are incapacitated and different from the others. It is better to use the term "individual exercises" and simply mention the fact that the student is being given some individual instruction, just as the drop kicker on the football team works alone to perfect himself in some department of his development which can be improved only by earnest individual effort.

Individual exercises differ from those of the regular physical education program in that they are made out, after careful examination of the pupil's needs and capacity, for the pupil's individual condition. The pupil may have various bodily defects which are not helped by the regular "Day's Order" type of work. To cause a subnormal individual to undergo a strenuous "Day's Order" drill often results in the boy's feeling that he is a failure. In many cases the exercises are beyond his ability at all, not to mention the bad form in which he might attempt to perform them.

A program of individually prescribed exercises must be administered to the subnormal individual. He should be known to the instructor as an individual and not as a number. The word "patient" is to be avoided, since the use of this term often causes introspection, morbidity, self-consciousness, etc. The student should be made to feel that he is working with the teacher toward a purposeful goal. His first series of exercises should be so light that he can perform them with a fair degree of success. As his courage rises, he can be given exercises which will be hard enough to act as a challenge to his ability.

Corrective Exercises as Assistance to Physical Education

The proper training and development of the individual during childhood and youth will give him that health consciousness and bodily vigor which will tend to continue throughout life. The detection and the correction of bodily defects now will mean that physical education in the future will not be confronted with so many boys and girls who are incapacitated for the average physical activity and athletics. It is well to emphasize the need for natural play life, but calisthenics and formal work are needed to develop the fundamental muscles of the body—to develop the strength and skill without which interest and success in games are likely to be lacking. This is the case with those who are not physically fit.

With a program which takes in ALL individuals the work of the physical educator will be received with more approval and approbation. The time is present when the coach or physical educator must know what to do for the boy who has a slight valvular difficulty, a loose inguinal ring, or whatever else the case may be. With this correction of deformity or disability in the child, the same child will be normal in adult life. Physical education will have done something more for him than to teach him a few games which cannot be carried on after he leaves school. It is not unusual to find structural and organic difficulties in the adult which can be traced back to neglected defects in childhood. Thus the child is the one who must be taught the rules of the game of health. Adults are poor pupils. It is hard for the adult to unlearn the things which he has been doing for years. Modern health instruction for the adult tends mostly toward a removing of bad habits which have been practiced all his life.

The boys and girls of to-day are the men and women of to-morrow. The average child has no prejudices to overcome. It is not difficult to interest him in the game of health. Childhood is the golden age of life in which to teach habits of right living. Educators should see the larger field of physical education and the wonderful opportunities contained therein. To assist in the proper development of the plastic child so that he will grow to be the right kind of an adult and citizen, is something worthy of our best efforts.

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CHAPTER III

FUNDAMENTAL PHYSIOLOGY OF EXERCISE

The teacher of preventive, corrective, and remedial physical education must thoroughly understand the effects of exercise on both the normal and the subnormal individual. This chapter will deal only with the main principles of the physiology of exercise. For greater detail the reader is referred to the works of such men as Bainbridge, Barringer, Barach, Burton-Opitz, Crampton, McCurdy, Sargent, Williams, and others. Where there has been a lack of training in physiology of exercise the prospective teacher of corrective and remedial work should study more fully the works of these various writers on the subject.

Williams lists the beneficial effects of rational exercises as follows:

"1. Increased circulation through the part of the body (as in special corrective work) or through the entire body. This circulatory activity carries food to the tissues, removes waste, distributes the endocrine secretions, and equalizes the water and heat content of the body.

"2. Increased respiration that gives increased oxygenation of the blood and of the tissues, and increased elimination of carbon dioxide. These values are dependent upon body activity and do not flow from the respiratory movement itself.

"3. Increased elimination of waste through kidneys, lungs, intestines, and, to some extent, skin.

"4. Increased metabolic changes. Digestion is improved, assimilation accelerated, and nutrition in general heightened.

"5. Increased neural activity, resulting in part from the increased circulation and elimination, and in part from the awakened kinesthetic senses." [1]

In general it can be said that exercise, especially of the large muscle type, is favorable to the circulation. It makes for better balance between the accelerator and inhibitory nerve fibers of the heart muscle. Through the coronary supply there is direct nourishment to the heart. It establishes a better balance in the respiratory and eliminatory systems by the contraction

[1] Williams, J. F., *Personal Hygiene Applied*, p. 118, Saunders Co., Philadelphia, Pa. (2nd Edition).

and relaxation of the various groups of active muscles. Formerly, it was believed that deep breathing, *per se*, resulted in an increased oxygenation of the tissues of the body; it is now known that the demands of the exercise cause the respiratory activity. Walking (large muscle movements) causes respiratory activity and oxygenation of tissues which cannot be secured by deep breathing. The action of the excretory system of the body is accelerated by exercise. The heat regulating factors function more efficiently because of exercise. The muscle tone of the digestive tract is increased by exercise. Cellular activity is increased and growth stimulated. The skeletal system is nourished and increased in power and coördination, and thus the efficiency of the body as a machine is increased. Beyond raising the neuromuscular efficiency of the body, the better balance between physical and nervous expenditure is further developed by rational exercise of the large muscle groups. The importance of exercise as one of the modalities in physical therapeutics is readily seen.

Unfortunately many people think of exercise in terms of muscular development alone. The old trainer, Mike Murphy, has been quoted in the significant statement that you can't make a cow trot. Many of the physical monstrosities who cavort about (in pictures!) clad in leopard or other skins do not portray what the physical educator desires as good physical development. The physical educator is concerned with muscular development in so far as it makes for better carriage and better efficiency in carrying out the dictates of the mental side of the individual. He is much more concerned with good function of the organic system than with muscular development great enough to merit the front page of some physical culture magazine. The functional efficiency of the heart and lungs, and the nervous, metabolic and excretory systems, as well as reasonable efficiency of the muscular system, is the object of modern physical education.

Types of Individuals Found in the Corrective and Remedial Classes

The average individual who is classified for "corrective" work presents one or more of the following conditions:

a. A lack of fundamental development of the skeletal system.
b. A lowered organic and skeletal tone or general debility.
c. A lack of organic vigor.
d. Poor sensory motor control (poor balance in the functioning of physiologically opposed muscle groups. [For example, anterior chest muscles are tight and short while the posterior or upper back muscles are relaxed and lengthened.]).
e. Lessened flexibility throughout the body (lack of general adaptability to movement of body parts).
f. Emotional instability.

The Use of Exercise for the Subnormal Individual

Having in mind the effects of exercise on the normal individuals and on the types of abnormals who take corrective work, the teacher must prescribe exercises which will be within the capacity of the individual and yet meet his needs and requirements. The teacher must first compare the effects of exercise on the normal individual with the effects of exercise on the subnormal individual.

The Circulatory System. Exercise forces blood through the veins in the direction of the heart by,

1. The contraction of the muscles incident to joint flexion and extension and consequent mechanical pressure which the muscles exert on the veins.
2. The alternation of intra-thoracic and intra-pulmonic pressures on the veins during the respiratory movements.
3. The deeper and more vigorous action of the diaphragm and the abdominal muscles, as well as the muscles of the pelvic floor.

The output of the heart being dependent upon the amount of blood in it at the end of each rest period, the contraction action of the muscles during exercise augments the return flow of blood to the heart.

Many people believe that exercise should be contraindicated in heart disturbances but this is true only in acute cases. The heart cases which are found in school and in the gymnasium are not acute cases. To be sure, circulatory acceleration by exercise means augmented heart activity, but increased circulatory activity carries nourishment to the various parts of the body, and the heart itself has improved nutrition through the added inflow of blood through its coronary arteries as part of this general circulatory improvement. Further, due to the increased circulatory activity, there results an elimination or removal of waste products. Rapid movements of the larger muscles would, no doubt, cause too much circulatory activity in the average case of heart lesion. In place of rapid movement the student with a heart lesion is given carefully graded, slow, rhythmical exercises. With suitable rests between movements the circulatory system is gently stimulated, and an improvement in organic function results. Instead of making the vasomotor system offset the effects of gravity, which it would be forced to do if the body were in the erect position, the exercises should be given in the recumbent position. Under these conditions exercises can be given profitably even in cardiac cases.

The increased respiratory efficiency results in oxygenation of the tissues of the body, removal of waste, and, by the aspiratory action of diaphragm, an increase in the circulatory activity. These conditions are secured without undue strain on the body as a whole. The increased excretory activity

furthers the removal of waste products and prepares the body for further activity.

Owing to the lowered metabolism in the average corrective case, the increased metabolic activity which accompanies exercise is of great value in restoring organic vigor and efficiency.

The increase in cellular activity and growth is especially helpful for the individuals with poor fundamental development, lowered tone and insufficient organic vigor. Rational exercise develops a better balance between the nutritive demands of the muscular system and the energy producing factors. With better muscle tone work can be accomplished with greater efficiency and with less fatigue.

It is with the increased neural activity that the corrective work is especially concerned. The whole neuromuscular or psychological-motor muscle mechanism is considered as a unit with two main aspects, the sensory and the motor. The result of properly applied physical education is a more efficient coöperation of the muscles and nerves. Sensory impressions which affect the surface of the body are conveyed to the nerve centers and cause a motor response. Complicated movements involve higher nerve centers. Simple movements involve lower nerve centers. By repeated training the response to sensory impressions becomes more nearly automatic, and nervous and physical energy are thus conserved. This fact explains why a trained athlete uses his body in physical activity in such a graceful manner. The untrained individual may make the same movement only with great difficulty if at all. Constant repetition of certain movements results in what is called "reflex action." We walk without giving any appreciable attention to the nervous and physical mechanisms which make this movement possible. Walking thus becomes a reflex action. The task of physical education, as it affects the neuromuscular mechanism, is to allow a more efficient working of this very important system, and more reflex action.

In summary it can be said that the beneficial effects of exercise on the normal individual are readily secured in work with the subnormal, providing there is a slight decrease in the speed and vigor of the exercises. The benefits to the various systems of the body are even more pronounced in the subnormal individual than in the normal individual. This result is due in a large measure to the fact that the subnormal individual is sadly in need of muscular exercise.

Types of Exercises Used in Corrective and Remedial Physical Education

A. *Passive Exercise* is that type in which the body parts are manipulated by the instructor, or by some external force, without active effort on the part of the recipient. The effects of passive exercise on the circulation, respira-

tion, metabolic processes, etc., are very much less marked than the effects of active exercise. But passive movements are of greatest value in joint affections, paralysis, extreme muscular weakness or general debility, etc. Passive exercise alone produces greater mobility in a part—in joint affections it breaks down adhesions—but active exercise and other physical modalities are necessary to develop the strength, coördination and endurance for proper functioning of the parts involved. Passive exercise is generally succeeded by active exercise and then by resistive exercises as the condition of the patient improves. Even passive exercise should not be used in painful joints.

B. *Assistive Exercises* are those in which the patient actively moves a part as far as he is able to move it and the instructor then assists the movement for the purpose of supporting the weight of the parts to reduce the load or localize the effort. Active exercises increase the range of movement within physiological limits and stimulate the return of fuller conductive power in the nerve paths. In cases where a dislocated shoulder has been reduced and the patient has been given rest and other physiotherapeutic treatments, it is often necessary to assist the patient in putting the arm through the normal physiological range of movements. In cases of paralysis when the injured motor neurons are able to perform a part of the movement, assistive exercises will be of great value in increasing the conductive power in the motor nerve paths.

Assistive exercises may be of an indirect type. In hemiplegia a movement is performed on the healthy side at the same time it is being attempted on the affected side. Another form of assistive exercise is the use of the warm bath for paralysis cases. The patient's limbs are supported by the mass of water displaced, and he can perform his exercises with this aid much more efficiently than when the same exercises are attempted against gravity.

C. *Resistive Exercises* are movements made by the individual in opposition to the movement by the instructor, weights, the individual's own antagonistic muscles, friction, etc. The Schott exercises, which are commonly used in heart cases, are of the resistive type. The object is to resist the patient in his attempt to place the part in the desired position. Resistive exercises are of great value in contractures.

It must be understood in connection with resistive exercises that the greatest resistance should be given after the limb has passed through the first third of its range of movement, and resistance should be lessened after two-thirds of the range of movement has been completed. In other words, the first third of the range of contraction finds the muscle at a poor leverage position. When the first third of the movement has been completed, the muscle is then doing what is called "the optimum of the muscle contraction." It is strongest during this second third of the movement. Resistance is then lessened to allow the weaker, last third, of the contraction to continue.

Where incorrect resistance is offered, too many synergistic muscles become involved in the movement. In such cases the parts which should be exercised are not exercised properly, if at all.

Resistive exercises are of three distinct types:

1. Static. The limb is held in a rigid position, causing the flexor muscles and the extensor muscles to preserve the equilibrium.
2. Concentric. The forearm is flexed against resistance to this flexion.
3. Eccentric. The forearm is extended against resistance to the movement of extension.

D. *Active Exercises.* These movements are of a purposive nature, initiated by the individual, either consciously or unconsciously, due to a stimulus from within or without. The beneficial effects of exercises are more fully realized in normal individuals by the use of active exercises than by the various other types mentioned. Since the object in corrective work is to make the individual as nearly normal as possible, there is a constant striving for the use of normal (active) exercises in all corrective work.

When the teacher uses active exercises in corrective work, he does not have to give his entire attention to one student as he does in passive exercise work. His energy is thus conserved when the student is doing active exercises. The work done in the gymnasium should consist of instruction and practice in what must be continued while outside of the gymnasium, and active exercises meet this requirement by giving the student something which he can perform at home without apparatus and without the aid of the teacher.

Active exercises are chiefly of the following types:

Speed.	Skill.
Strength.	Endurance.

Endurance Exercises. Although preventive and corrective work does not confine its activities to any one type of exercise, the endurance type of active exercise is most commonly used. In endurance exercises there is a relatively slow movement which is followed by sufficient rest to enable the part exercised to become relieved of the fatigue products of one movement before another movement is begun. The heart beat, walking, etc., are good examples of endurance exercises. Endurance exercises spare the organism while improving the organic function. The relatively slow periods of contraction and relaxation and the absence of skill or effort required, make endurance exercises suitable to the majority of conditions found in corrective cases. To secure the greatest good from endurance exercises in corrective work, the large muscles are used more than the smaller muscles. A large expenditure of physical energy by the larger muscles of the body necessitates only a relatively small expenditure of nervous energy.

Fatigue

According to Goldmark,[1] two processes of cellular life are continually carried on in the living body:

1. Assimilation, or building up, known as anabolism.
2. Disassimilation, or breaking down material into simpler chemical forms (ultimately expelled as waste products), known as catabolism.

Upon these two processes together, or metabolism, life itself depends, and to this fundamental basis of life we must turn for an explanation of what fatigue is. From Goldmark's description of metabolism fatigue means a diminution of energy-producing material plus an accumulation of waste products, such as lactic acid, carbon dioxide, monopotassium, etc.

Fatigue manifests itself in a lessened ability to perform accustomed work without assistance of further stimulation. This fatigue is closely connected with symptoms of nervous and muscular inefficiency. Though not generally admitted as fact, it seems clear that fatigue must be considered as an accumulation of toxic matter which is produced faster than it can be eliminated. The nerve end-plates are the first to become fatigued and thus protect the muscular system from the same condition. The fatigue of the nerve end-plates thus prevents absolute exhaustion.

Fatigue is of three types:

1. Subjective fatigue.
2. Objective fatigue.
3. Chronic fatigue or staleness.

Subjective fatigue shows in lessened nervous energy and subsequent mechanical performance. The central nervous system is affected. But due to acquired skill this mechanical performance may not be noticed.

Objective fatigue manifests itself by a lessened sensitivity of the motor end-plates. This may be due to a diminution of the energy-producing substances plus an accumulation of fatigue products.

Staleness is a condition of chronic fatigue which has been continued for a period of days or weeks. The individual loses weight. He looks thin and drawn. His night's sleep fails to restore energy, his appetite is poor, and he has a general feeling of lassitude. His change from the horizontal to the erect position produces an exaggerated increase in pulse rate. His work is very noticeably poor. In chronic fatigue rest is indicated, preferably supervised, as much if not more than is exercise. Such a condition should be prevented by physical education. Physical education should develop

[1] Goldmark, J., *Fatigue and Efficiency,* p. 12, Russell Sage Foundation, New York, 1917.

resistance to fatigue and staleness. Corrective exercises aim to build up the individual's resistance against fatigue by increasing the organic vigor.

Training

The body, considered as a machine, shows an efficiency of twenty to thirty-three per cent.[1] Few individuals use their bodies efficiently, and training aims to increase their efficiency. The object of training is NOT to increase strength alone, but to promote better function of the vital organs, to develop better neuromuscular responses, and to allow a more efficient response of the body to its environment.

Due to training, the various organs function more efficiently. Exercise increases the demand of the muscles for nourishment and oxygen. Ten times more blood flows through certain muscles during heavy exercise than when the muscle is at rest. The heart beats more slowly but more powerfully under the influence of training. There is a slight physiological hypertrophy. The *rate* of respiration may be increased with training, but the net result is a *deeper* respiration, which, by the aspiratory action of the diaphragm augments metabolism in the organs of nutrition. The increased oxygen supply to the blood and from the blood to the various parts of the body results in better muscular power and organic efficiency. There is a relief of congestion in the visceral organs. Where training involves the use of the larger muscles of the body, thus demanding relatively little nervous expenditure, there results normal fatigue which relieves nervous strain and induces refreshing sleep.

In preventive and corrective work the emphasis is on better neuromuscular coördinations, which are best developed by active exercises, and on the increased efficiency and tone in the vital organs and skeletal muscles. The average student taking preventive or corrective work must be taught to use his body more efficiently. The vigorous training given to athletes is, of course, out of place with the corrective group. The principles, however, remain the same. The function of the heart must be improved, the respiratory apparatus must be trained to perform its work more efficiently. The tone of the skeletal muscles must be raised so that good body mechanics will be possible. Thus rational exercise is recognized as a very valuable aid in promoting physical well-being in the physically subnormal individual.

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CHAPTER IV

BODY MECHANICS

Since the time of the early Greeks, emphasis has been laid on the desirability of "good posture." Expressions like "correct carriage and a graceful step"[1] show that the stress was largely on the æsthetic factor. And it still is: few children have escaped the command, "Throw your shoulders back!" The ungainly appearance of the child in poor posture induces the parents to try to improve this appearance by the above command. A greater stress is given now, however, to the health and efficiency side—to the need of normal functioning of the bodily organs gained only when the various segments of the body are properly aligned. Dr. Joel Goldthwait's article, "The Relation of Posture to Human Efficiency,"[2] written in 1909, deals extensively with the influence of body poise upon the support and *function* of the viscera. From 1909 until we entered the war, physical educators, doctors, and other health agents were directing more attention to the consideration of the relation of correct alignment of the body and efficient organic function. The term "Body Mechanics" had its origin in the work of Dr. Lloyd Brown and Dr. Roger Lee, of Boston, Massachusetts. The term was first used in the classification of the entering Harvard freshmen in 1916. The term "body mechanics" is now used to replace the more limited term of "posture."

Poor posture is one of the characteristics of faulty body mechanics. When the human machine is not properly balanced, the individual must use his body at a mechanical disadvantage. In this poorly balanced position the functions of the vital organs are impaired. Thus correct body mechanics is emphasized for the purpose of allowing the vital organs to function at their highest efficiency. This correction of faulty body mechanics is not offered as a panacea for all ills. The correction will, however, assist nature in compensating for the various defects and give the body a better opportunity to perform its various functions with less difficulty.

Theoretically it is admitted that correct body mechanics assists in permitting the organs of the body to function more efficiently. In practice,

[1] Leonard and McKenzie, *History of Physical Education,* p. 21, Lea and Febiger Co., 1923.

[2] Goldthwait, Joel, "The Relation of Posture to Human Efficiency," *Amn. Jour. of Orthopædic Surgery,* 7:372, 1909.

however, the health value of correct body mechanics is often overlooked. People as a whole are willing to accept the theory of many health principles, but they are not always willing to practice what they believe. Many people realize that carious teeth are detrimental to health, and yet the most prevalent defect in children and adults to-day is carious teeth. Because a disease or defect does not exhibit itself immediately in an inability to perform the daily activities of life, these diseases and defects are often overlooked. The body may so compensate for these defects and diseases that they never manifest their presence by actually disabling the individual. In spite of this compensation, however, the body is not functioning at its greatest efficiency, and therefore an individual with faulty body mechanics is not functioning at his greatest efficiency.

With the emphasis on "pre-symptoms" and prevention of defects and diseases, attention should be given to faulty skeletal alignment as a causative factor in ill-health and impaired efficiency. More practical application of health principles is necessary. The gymnast, in many cases, fails to emphasize strongly enough the importance of correct body mechanics as a means of increasing the organic efficiency of the body. It is discouraging to see a gymnasium class doing simple calisthenics, with abdomens protruding, backs hollowed, heads forward, chests depressed and feet turned out. The proper pelvic obliquity is rarely seen. In many cases the physical educator himself is not using correct body mechanics.

FIGURE 8-A

Incorrect use of chest weight machine

To many people, exercise, as done in the gymnasium, seems better than no exercise at all. Unfortunately these people fail to consider that exercises which develop incorrect poise of the body are developing the body in a position which will prevent the normal functioning of the vital organs and the skeletal muscles. A glance in the average gymnasium will reveal round-shouldered individuals, with their backs toward the chest weights, pulling the weights and further shortening their short chest muscles, while their elongated back muscles are further over-stretched.

See Figure 8 (Incorrect and correct use of chest weight machine).

Gymnasium exercises of the "Day's Order" type grew out of the conviction of Hjalmer Ling. Ling realized that the flexor muscles of the body

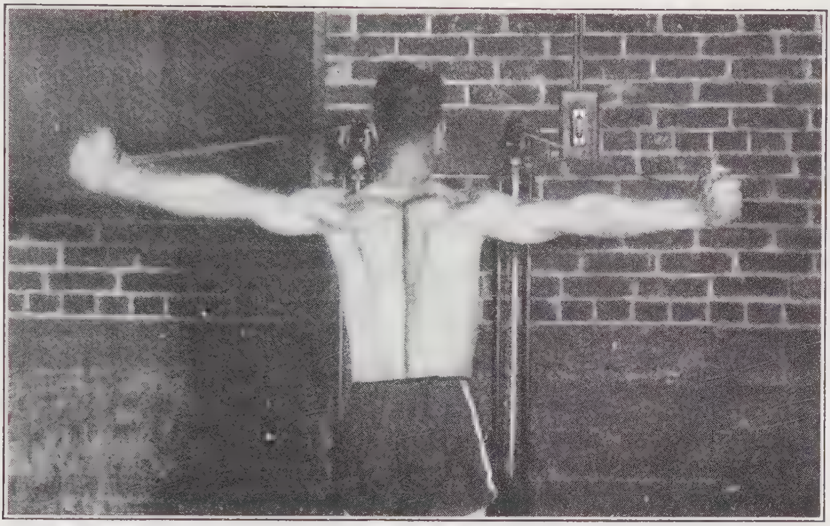


FIGURE 8-B
Correct use of chest weight machine

received more exercise than the extensor muscles. As the extensor muscles are the ones which are most concerned with maintaining the erect position of the body, the extensor muscles should be exercised sufficiently to preserve good balance between the flexors and the extensors. The gymnasium exercises should contain enough of the corrective element to overcome the baneful effects of overdeveloped flexor muscles and underdeveloped extensor muscles. But this corrective element is missing in the majority of gymnasium classes.

I. THE NEED FOR CORRECT BODY MECHANICS

The evidences of faulty body mechanics are all about us. Perhaps familiarity breeds oversight. Actually to *see*—not merely to *look at*—a group of individuals in a classroom, or walking along the street, will convince one that very few individuals carry themselves in correct body poise. Although physical educators long ago realized that poor body mechanics was very prevalent, they needed a set of startling figures to awaken them to action. Harvard furnished these figures when she showed that more than three-quarters of her 1916 freshman group were not using their bodies in a correct mechanical manner. The figures for these freshmen are:

A. Good Body Mechanics	7.5 per cent.
B. Fairly Good Body Mechanics	12.5 per cent.
C. Poor Body Mechanics	55.0 per cent.
D. Very Poor Body Mechanics	25.0 per cent.

Again, in 1919, after the war, the entering class was examined. The students were rated on:

1. Habitual standing position.
2. Directed standing position (the instructor told them how they should stand, and they attempted to make the necessary correction of their own bodies).
3. Foot position (if a student used his feet incorrectly, such as turning them out, he was placed in class "D" regardless of how he rated on No. 1 and No. 2. Ten and five-tenths per cent. used their feet poorly although compensating enough to rate good body mechanics).

The Harvard figures were of freshmen who had had "good physical training." These freshmen had been "exposed" to physical education in very good public and private schools.

Surely with the advantages of "good physical training" there should have been more "Good" and "Fairly Good Body Mechanics" than "Poor" and "Very Poor Body Mechanics." Some of the athletes were classed in the low-grade "C" and "D" groups. But the results of the Harvard examination proved that a correlation does exist between very poor body mechanics and organic insufficiency. The "C" and "D" men did not measure up to the health standard of the "A" and "B" groups. Backache, functional albuminuria, appendicitis, constipation, abdominal pains, abdominal weakness, general body fatigue, malnutrition and other minor ailments were more prevalent in the "C" and "D" groups than in the "A" and "B" groups. After all the matter of good body mechanics is that of good or poor organic function.

The writer sent a questionnaire to the leading colleges and larger high schools throughout the Middle West and West asking for information regarding their "posture work" activities. It was not uncommon to learn that the "Harvard system of classification" was being used as their guide. The answer to the question, "What percentage of students is found in the various 'A,' 'B,' 'C' and 'D' groups?", gave, as an average group rating the following:

A. Good Body Mechanics	7. per cent.
B. Fairly Good Body Mechanics	13. per cent.
C. Poor Body Mechanics	60. per cent.
D. Very Poor Body Mechanics	20. per cent.

These figures correspond very closely to the figures of the yearly freshmen examination at the University of Illinois. Miss L. Drew in the last edition (third) of her splendid book, *Individual Gymnastics*, writes that her

BODY MECHANICS

The right way | The wrong way

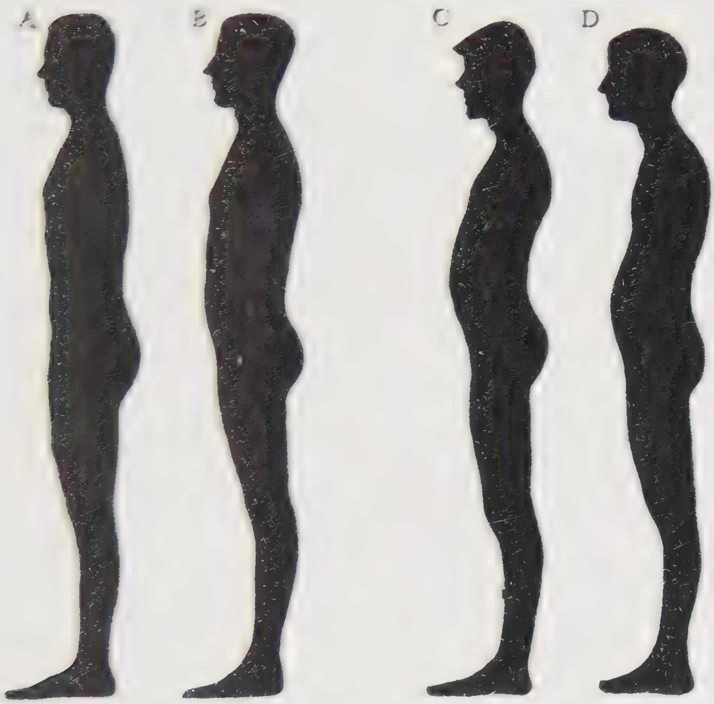


Figure [illegible]

(A) Excellent Mechanical Use of the Body

[illegible]

(C) Poor Mechanical Use of the Body

[illegible]

(B) Good Mechanical Use of the Body

[illegible]

(D) Very Poor Mechanical Use of the Body

[illegible]

studies of college women were "surprising in the similarity of results to those obtained by Dr. Brown of Harvard."[1]

The figures quoted above are fairly constant for college men and women. The methods of examination and the personal equation of the examiners must be taken into consideration in the slightly different figures which are given by various universities. When the examination is conducted on a functional basis, an habitual attitude of abduction ("out-toe position") of the feet would demand a body mechanics rating of "D" as at Harvard. This functional examination is conducive to preventive work. When the individual is rated entirely on a clinical basis preventive work is naturally limited, as the individual is marked satisfactory until definite clinical disturbances are manifested. It is well known that the more definite the clinical symptoms the more difficult is the correction. Thus with abducted feet and good posture the clinical rating might be "A," as the body has compensated (due to natural vigor) for the abduction of the feet. This muscular compensation does not always continue, and a functional rating of "D" would cause the individual to correct his foot condition and thus relieve the body of the need of compensating for the faulty foot position. Preventive work thus corrects conditions, which, though not serious at first, often become serious if allowed to continue without any attempt at correction.

II. BODY MECHANICS FOR CHILDREN

Faulty body mechanics is not confined to college students. We are aware of the college student's faulty body mechanics or "college slump" because of the figures which have been compiled. The Life Extension Institute of New York reports that 44 per cent. of the adults examined by their institution have faulty body mechanics. Battle Creek Sanitarium finds but few of its patients with correct body poise. The business man of to-day is characterized as "slumped over." The figures for the housewife, the mother and the business woman all show a preponderance of "C" and "D" postures over the small number of "A" and "B" postures.

Children in the secondary, elementary and kindergarten schools are not good examples of correct body mechanics. There has been a dearth of figures showing the body mechanics classification in these schools. The recent activity in "pre-school" examinations has showed that the child who is about to enter school has, in the majority of cases, poor body mechanics. The examinations in elementary schools, though perfunctory in many cases, reveal the fact that over 70 per cent. of the elementary school children need correction for their existing faulty body mechanics. The figures for the

[1] Drew, L., *Individual Gymnastics,* Lea and Febiger Co., p. 87, Third Edition.

secondary schools are almost identical with the college student body mechanics figures.[1]

It is a lamentable fact that our present system of physical education delays its corrective and preventive work until the individual reaches college. The greatest need is in the elementary school group. The longer an individual continues his education, the less he absolutely needs a vigorous body. The average boy who leaves school at the end, or before the end, of his elementary school course is destined to use his physical energy more than his mental energy in earning his living. He usually secures a position which demands little neural expenditure in proportion to physical expenditure. Yet the boy who leaves school after only his elementary course finds that his physical side has been the one most neglected in his elementary school career. It seems reasonable to suggest that those to whom physical energy is absolutely necessary for earning a living should be the first ones to be put in first-class physical condition. On the other hand, those who continue their education receive more and more attention to their physical welfare. Corrective exercises, gymnastic exercises, athletics, etc., are provided for the high school and college student. Yet these better educated students, though needing good bodies, are not as a rule destined to depend on their physical brawn to the same degree as the less educated boys in the earning of a living. Surely here the emphasis is wrong. The attention of educators, boards of education, supervisors, taxpayers, etc., should be directed to the elementary school group *first,* and to the secondary and college groups *second.*

The postponement of this aid works a more general evil also. A child who enters school with physical defects and faulty body mechanics is destined to combat these handicaps until he reaches secondary school or college. When he enters college the physical defects and faulty body mechanics are, in too many cases, so firmly established that correction is impossible, or at least very difficult. A child does not outgrow his physical defects and faulty body mechanics without guide and aid; he actually accentuates these conditions. He also establishes more firmly the abnormal habits which accompany his defects. See Figure 10.

When one considers the extreme plasticity of childhood, he realizes at once the value of eradicating this poor body mechanics evil at its source. If proper emphasis is given to this work by thorough health examinations before a child enters school, and if proper follow-up work and inspection is conducted throughout the elementary school period, then there will not be the large majority of students entering college with deformed bodies as there is at the present time. Fewer boys and girls will begin unskilled work

[1] *See Annual Report of the Dept. of Health and Corrective Physical Education,* July, 1926-July, 1927, Los Angeles City School District School Publication No. 150.

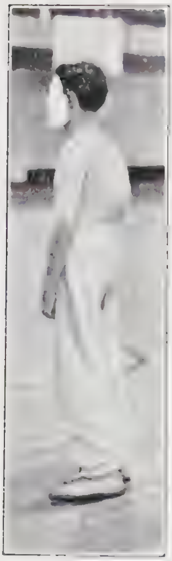


FIGURE 10

FIGURE 10-A

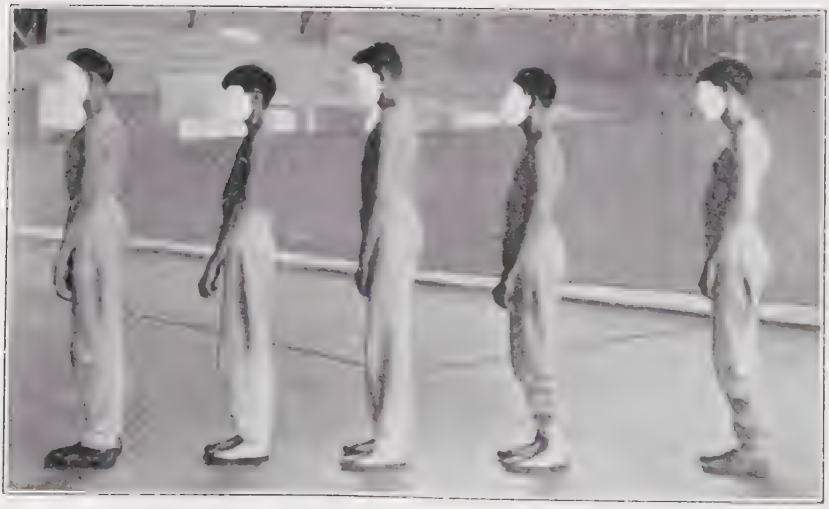


FIGURE 10-B
College Students Who Have Not Outgrown Their Physical Defects

in stores, factories, etc., with bodies which are destined to break down under the strain of their tasks. The body of a child of sixteen to twenty years and older is not so amenable to correction as it was ten or fifteen years earlier. Due to the gross neglect of the physical health of the elementary and, to a large extent, of the secondary school children, colleges and universities are confronted with structural deformities which can be repaired only with great difficulty and in many cases not at all. Correction should have been begun ten years earlier. Pasadena has demonstrated this point in the work done by Miss Colestock, where group grading in the elementary schools has reduced the need of these children being put in the corrective department in the high school. A system of education which allows a child to go through the elementary and secondary schools without correction of physical defects is imposing upon the child the herculean task of securing his education under great difficulties, for he is continually expending energy in compensating for defects of the body which should be devoted to mental tasks. Is it any wonder that so many children leave school at the end of their elementary work or after a year or two of high school?

The educational system alone cannot be blamed for the large number of physical defects found in college students. Parents shirk their responsibility in helping the schools in the majority of cases. Many parents who object to an increase in taxes which is made necessary for the health work in the schools are loud in their complaints that the schools are not taking care of the health interests of the children. It costs money to conduct health examinations. It costs more money to combat long-standing diseases and bodily defects. Parental coöperation in matters of health for the school child is necessary.

Parents, as a rule, are lax, too, in their inspection of the young child's body. The thoughtful parents are only gradually coming to realize that a periodic medical and physical examination is proper for themselves, and also for their children. Numerous authorities on child health have stressed the fact that careful watch and care of the child's health through the first ten years of his life will go a long way toward the development of that basic health which generally continues as the child grows older. It is illogical to blame the school for many of the defects in childhood when the average child enters school with these defects. If a child enters school with a good body, the chances of defective growth will be very small. It is the child who enters school with physical handicaps who is broken down by the confinement of the schoolroom. But since eye and teeth defects are most common, the eyes and the teeth of even the child with a perfect body should be tested at least once each year.

The matter of good carriage for children is not simply an æsthetic one; it has far greater significance than mere personal appearance. Parents must

be educated on this important point. The close correlation of poor body mechanics and poor organic function must be explained to the parents. The positive mental and physical health values which accompany body balance must be stressed until parents realize that health and physical efficiency are closely allied to good body mechanics.

Correction is more difficult in proportion to the duration of the defect. Hopes that the child will outgrow his faulty posture must be shattered by facts; the child will *not* outgrow faulty posture. The faulty posture becomes more firmly fixed as the condition is neglected. Parents must be convinced that, due to the natural plasticity of childhood, a defect will grow rapidly worse if nothing is done. On the other hand, correction of the defect is easy because of this same plasticity. The sense of muscle balance and the habit of correct poise must be developed, for if not, the child may strive sporadically for an erect posture, but he will constantly tend to develop in the abnormal plane every time his attention is distracted from improved alignment. As the child grows, he must constantly adjust his muscle balance to the correct body poise. Any deflection of his energy by poor body mechanics will tend to allow the distortion to become greater. It is the duty of the parents to see that skeletal alignment is developed in the home. And they themselves must be good examples of all that correct body mechanics portray.

III. THE PRINCIPLES OF CORRECT BODY MECHANICS

The spine at birth is straight. If the baby is held in the sitting position, his head and spine, as well as the remainder of the body, must be supported. Before the child can sit up, he learns to move the various parts of his body. When the child is placed in the prone lying position, he gradually learns to raise his head and develops the posterior neck and back muscles. By the time the child has learned to creep and to sit up, the cervical region is no longer straight but presents an anterior convexity. But the lumbar spine is still straight. As the child begins to pull himself to a standing position, the extension of the legs tilts the pelvis downward in front and causes a hollow to develop in the lumbar region. The spine then presents the normal physiological curves as follows:

1. Anterior convexity in the cervical region.
2. Posterior convexity in the thoracic or dorsal region.
3. Anterior convexity in the lumbar region.

The above curves, when not exaggerated, are normal physiological curves and are found in all subjects with correct alignment. These curves are maintained and the proper integrity of the bony framework of the trunk is preserved by continuous static ligamentous and muscular action.

The entire body is held in the erect position by the ligaments which bind the skeleton together and by the muscles which maintain balance throughout the body. The muscles of the front of the body are opposed in their action by the muscles of the back of the body. The result of this opposition, this action of antagonistic muscles and the like action of the muscles on the right and left sides of the body, is a balanced structure. When the body is in correct poise, the following characteristics are noted:

1. The body is held as tall as possible without strain.
2. The head is erect and the chin slightly drawn in.
3. The shoulders are slighty posterior to the center of gravity.
4. The chest is high.
5. The abdomen is in. (Abdomen flat.)
6. The spinal curves are not exaggerated. (Gentle curves.)
7. The pelvis is tilted slightly upward in front and downward in back. (Fifty-five degrees.)
8. The knees are straight but not stiff.
9. The weight of the body falls just back of the middle of the foot on the longitudinal arches (between the two tarsal scaphoid bones).
10. The body is free for movement without strain and with the least expenditure of energy.
11. The entire body is in true anatomical position.
12. The vital organs are free for most efficient function.

The above position is maintained with ease if the following requirements are satisfied:

1. The individual knows what correct body mechanics is.
2. The individual has had sufficient practice in the correct position. The muscle sense of the correct position must be fully developed.
3. Adequate organic vigor is present.
4. The individual possesses sufficient strength and tone of the opposing muscle groups.
5. There is sufficient length of ligaments and muscles to permit correct body position without undue strain on these ligaments or muscles. That is, there must be sufficient flexibility and normal range of movement. It must be possible to stretch to proper position the shortened parts and shorten the overstretched parts.
6. The external conditions for maintaining correct body mechanics are conducive to correct posture. Chairs must fit the body in good posture, etc.

Many people feel that the correct body mechanics position is more fatiguing than their habitual incorrect positions. To be sure, the old-style

position of "Attention," which is supposed to characterize the soldier, is fatiguing. In this position the body is stiff, the back muscles are overactive, and fatigue and muscle strain are very evident. In the correct body mechanics position there is very little strain. The body is in balance. Mechanical law tells us that the nearer to the center a weight is maintained the less expenditure of energy is required to maintain perfect equilibrium. This principle applies to correct body mechanics. The various parts of the body are aligned in a manner which demands the least amount of muscular and ligamentous support.

It is true that the correct body mechanics position is "strange" to many and the care necessary to establish new habits of posture is fatiguing at first. But when the balance becomes automatic, the energy expended in the correct position is not nearly so great as that which is expended when the muscles are constantly trying to maintain balance with the body parts out of proper alignment. An illustration of balance without strain is as follows:

> A telegraph pole when lying on the ground needs the combined efforts of many men to place it in the perpendicular position. When it is placed in the perpendicular position, a comparatively slight effort is all that is needed to maintain it in its position of balance.

With proper distribution of body weight, the legs, trunk and head are in a straight line. Thus the body is balanced with the least amount of strain when the weight is maintained as near to center as possible.

The emphasis to-day is not on pushing the shoulders back. Rather one must learn the proper alignment of the various body parts. One of the chief obstacles to the maintenance of correct body mechanics is the inability to establish a proper pelvic position. The hips are generally thrown too far back and the lower back is hollowed. The abdomen, lower back and pelvic area are the keystone segment of the three segments which are known as (*a*) the head, (*b*) the thorax, (*c*) the abdomen. Without a proper base the two upper segments are destined to be thrust out of proper position and into a position of poor body mechanics. This derangement necessitates an increased expenditure of energy to preserve the erect position.

The proper pelvic tilt is determined by the following measurements: The pelvis is tilted slightly upward in front and downward in back, to an obliquity of fifty-five to sixty degrees; if a line were drawn through the junction of the fifth lumbar vertebra and the promontory of the sacrum, extending downward and forward through the ilio-pectineal line and the top of the symphis pubis, this line would meet a horizontal line drawn through the pelvic base to form an angle of about fifty-five degrees.

See Figure No. 11 ("Pelvic Obliquity").

When the pelvis is in proper position, the Y ligament or ilio-femoral

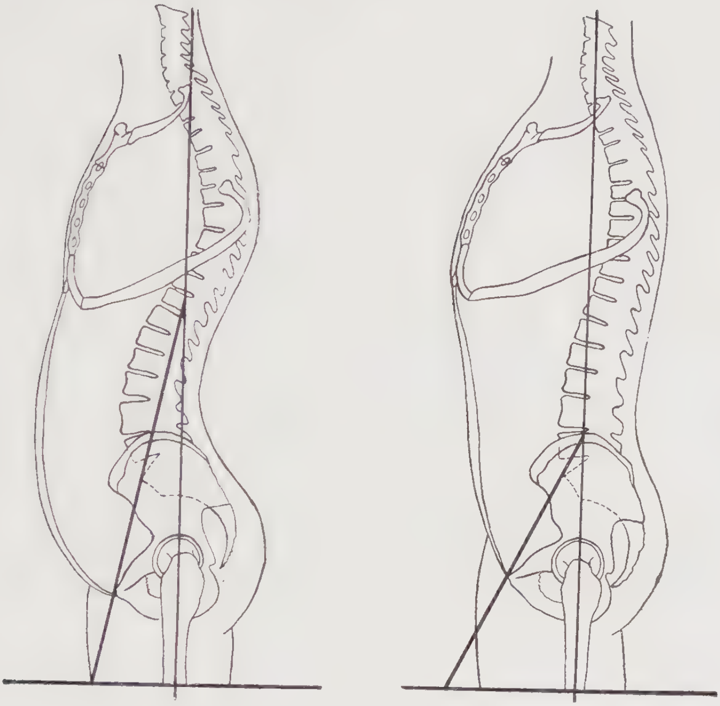


FIGURE 11
Pelvic Obliquity
(Incorrect and Correct)

band and the psoas muscles prevent a lessening of the forward inclination of the pelvis; the abdominals and gluteal muscles assist in preserving the proper tilt; the lower back presents a slight curve, and the abdomen is flat. Since this trunk base is in good position, the basic segment is correctly placed, and the thorax and head can be more readily kept over the center. Throughout the corrective and preventive work for poor body mechanics emphasis is continually directed to the proper tilt of the pelvis.

IV. PREVENTIVE MEASURES

Since poor body mechanics is so frequent in children and adults, the chief emphasis should be laid on the prevention of it. The first essential is that the student knows just what constitutes both good and poor body mechanics. Concrete examples such as the Harvard chart (see Figure 12) or the "Posture Standards" of the Children's Bureau, U. S. Department of

Labor (see Figures 13-18) are recommended. A glance at these charts shows the student what is good mechanical use of the body and what are the advantages of balance alignment.

BODY MECHANICS

THE RIGHT WAY *THE WRONG WAY*

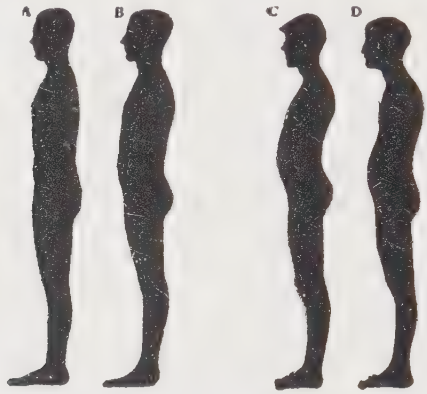


FIGURE 12

(A) Excellent Mechanical Use of the Body

1. Head straight above chest, hips and feet.
2. Chest up and forward.
3. Abdomen in or flat.
4. Back, usual curves not exaggerated.

(B) Good Mechanical Use of the Body
(Compare with Fig. A)

1. Head too far forward.
2. Chest not so well up or forward.
3. Abdomen, very little change.
4. Back, very little change.

(C) Poor Mechanical Use of the Body
(Compare with Fig. A)

1. Head forward of chest.
2. Chest flat.
3. Abdomen relaxed and forward.
4. Back curves are exaggerated.

(D) Very Poor Mechanical Use of the Body
(Compare with Fig. A)

1. Head still farther forward.
2. Chest still flatter and farther back.
3. Abdomen completely relaxed, "slouchy."
4. Back, all curves exaggerated to the extreme.

The above part of this page was prepared and issued by the Department of Hygiene and Physical Education, Harvard University, Cambridge, Mass.

Advantages of Good Posture

1. All muscles, bones and internal organs are properly adjusted and function at their best.
2. Spinal column has the normal curves permitting spinal cord and nervous system controlling bodily movements to function freely.
3. Denotes General Strength, Character and Personality.
   (a) Which of the above four postures seems to inspire in you the most confidence?
4. Good General Appearance.
   (a) Is general appearance an asset physically, commercially or socially; if not, why do we desire to look healthy, dress well or make a generally good impression?

Disadvantages of Poor Posture

1. Muscles, bones and ligaments poorly adjusted tending to cause lack of strength and tone with uneven strain on certain groups.
2. Flat chest impairing full use of lungs, relaxed and protruding abdomen, tending to cause sagging of the viscera, constipation, auto-intoxication.
3. Exaggerated spinal curves, tending to cause weakness of the supporting ligaments and muscles.
4. General Appearance Poor, lacking vigor, tone, poise and æsthetic quality.

Copy of chart used by one of the best preparatory schools in America

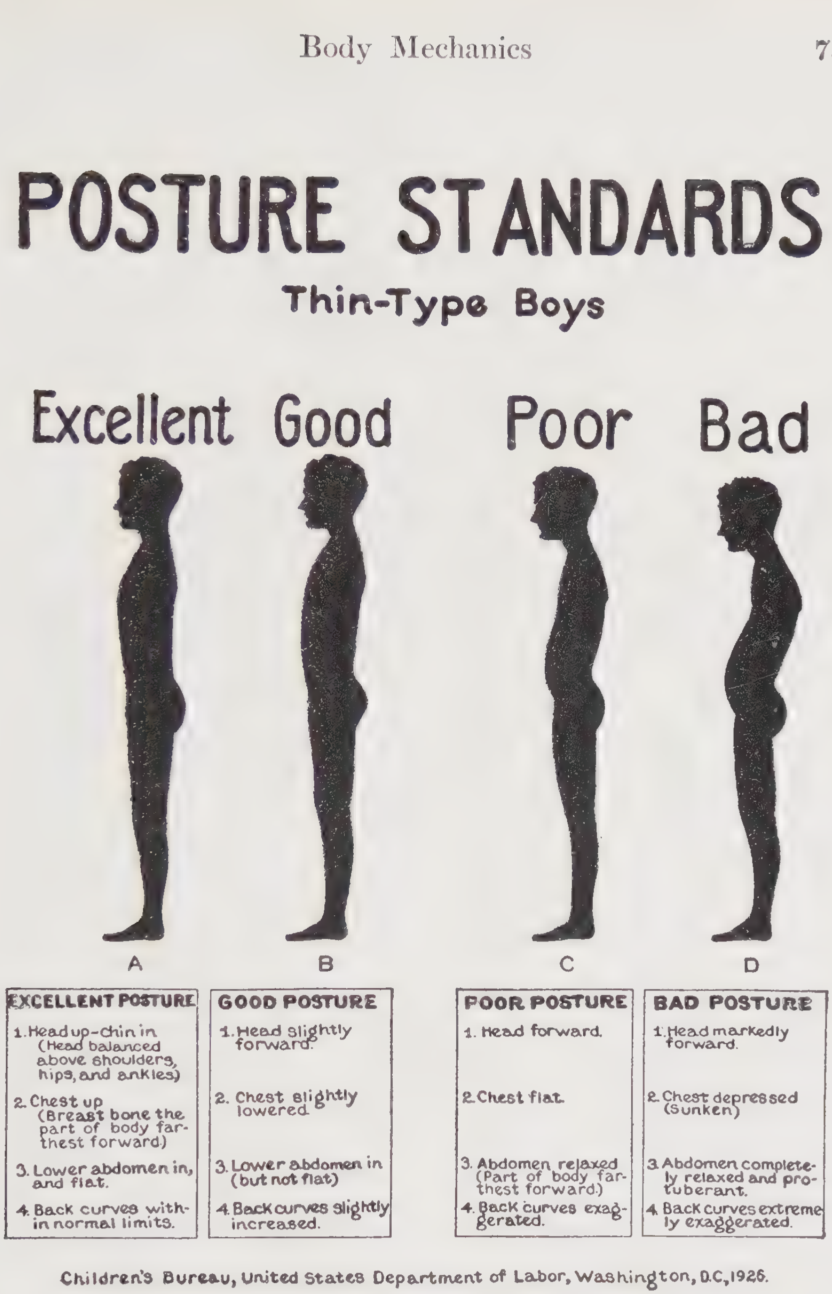

POSTURE STANDARDS
Thin-Type Boys
Excellent
Good
Poor
Bad
A
B
C
D
EXCELLENT POSTURE
1. Head up—chin in (Head balanced above shoulders, hips, and ankles)
2. Chest up (Breast bone the part of body farthest forward)
3. Lower abdomen in, and flat.
4. Back curves within normal limits.
GOOD POSTURE
1. Head slightly forward.
2. Chest slightly lowered.
3. Lower abdomen in (but not flat)
4. Back curves slightly increased.
POOR POSTURE
1. Head forward.
2. Chest flat.
3. Abdomen relaxed (Part of body farthest forward.)
4. Back curves exaggerated.
BAD POSTURE
1. Head markedly forward.
2. Chest depressed (Sunken)
3. Abdomen completely relaxed and protuberant.
4. Back curves extremely exaggerated.
Children's Bureau, United States Department of Labor, Washington, D.C, 1926.

FIGURE 13

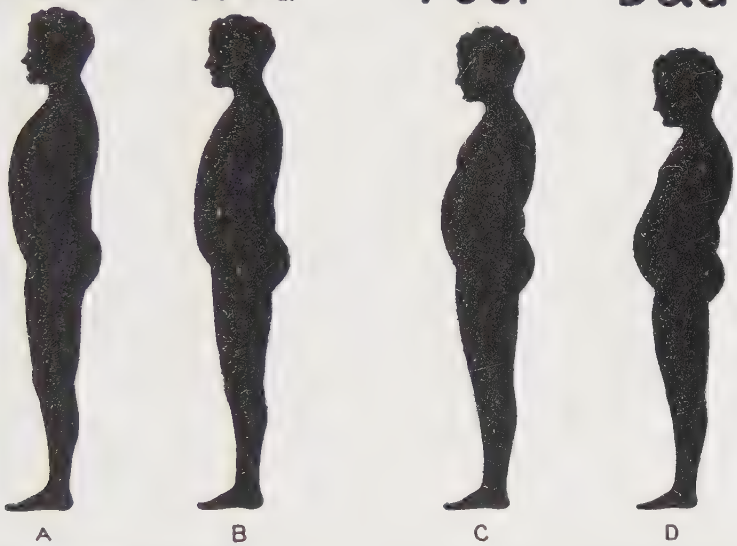

POSTURE STANDARDS
Intermediate-Type Boys
Excellent
Good
Poor
Bad
A
B
C
D
EXCELLENT POSTURE
1. Head up—chin in (Head balanced above shoulders, hips, and ankles)
2. Chest up (Breast bone the part of body farthest forward.)
3. Lower abdomen in, and flat.
4. Back curves within normal limits.
GOOD POSTURE
1. Head slightly forward.
2. Chest slightly lowered.
3. Lower abdomen in (but not flat)
4. Back curves slightly increased.
POOR POSTURE
1. Head forward.
2. Chest flat.
3. Abdomen relaxed (Part of body farthest forward.)
4. Back curves exaggerated.
BAD POSTURE
1. Head markedly forward.
2. Chest depressed (Sunken)
3. Abdomen completely relaxed and protuberant.
4. Back curves extremely exaggerated.
Children's Bureau, United States Department of Labor, Washington, D.C., 1926.

FIGURE 14

POSTURE STANDARDS

Stocky-Type Boys

Excellent Good Poor Bad



EXCELLENT POSTURE	GOOD POSTURE	POOR POSTURE	BAD POSTURE
1. Head up—chin in (Head balanced above shoulders, hips, and ankles)	1. Head slightly forward.	1. Head forward.	1. Head markedly forward.
2. Chest up (Breast bone the part of body farthest forward.)	2. Chest slightly lowered.	2. Chest flat.	2. Chest depressed (Sunken)
3. Lower abdomen in, and flat.	3. Lower abdomen in (but not flat)	3. Abdomen relaxed (Part of body farthest forward.)	3. Abdomen completely relaxed and protuberant.
4. Back curves within normal limits.	4. Back curves slightly increased.	4. Back curves exaggerated.	4. Back curves extremely exaggerated.

Children's Bureau, United States Department of Labor, Washington, D.C., 1925.

FIGURE 15

POSTURE STANDARDS

Thin-Type Girls

Excellent	Good	Poor	Bad

A	B	C	D
EXCELLENT POSTURE	**GOOD POSTURE**	**POOR POSTURE**	**BAD POSTURE**
1. Head up—chin in. (Head balanced above shoulders, hips, and ankles)	1. Head slightly forward.	1. Head forward.	1. Head markedly forward.
2. Chest up (Breast bone the part of body farthest forward)	2. Chest slightly lowered.	2. Chest flat.	2. Chest depressed (Sunken)
3. Lower abdomen in, and flat.	3. Lower abdomen in (but not flat)	3. Abdomen relaxed (Part of body farthest forward)	3. Abdomen completely relaxed and protuberant.
4. Back curves within normal limits.	4. Back curves slightly increased.	4. Back curves exaggerated.	4. Back curves extremely exaggerated.

Children's Bureau, United States Department of Labor, Washington, D.C., 1926.

FIGURE 16


POSTURE STANDARDS
Intermediate-Type Girls
Excellent Good
Poor Bad
A
B
C
D
EXCELLENT POSTURE
1. Head up—chin in (Head balanced above shoulders, hips, and ankles)
2. Chest up (Breast bone the part of body farthest forward.)
3. Lower abdomen in, and flat.
4. Back curves within normal limits.
GOOD POSTURE
1. Head slightly forward.
2. Chest slightly lowered.
3. Lower abdomen in (but not flat)
4. Back curves slightly increased.
POOR POSTURE
1. Head forward.
2. Chest flat.
3. Abdomen relaxed (Part of body farthest forward.)
4. Back curves exaggerated.
BAD POSTURE
1. Head markedly forward.
2. Chest depressed (Sunken)
3. Abdomen completely relaxed and protuberant.
4. Back curves extremely exaggerated.
Children's Bureau, United States Department of Labor, Washington, D.C., 1926.

FIGURE 17


POSTURE STANDARDS
Stocky-Type Girls
Excellent
Good
Poor
Bad
A
B
C
D
EXCELLENT POSTURE
1. Head up—chin in (Head balanced above shoulders, hips, and ankles)
2. Chest up (Breast bone the part of body farthest forward.)
3. Lower abdomen in, and flat.
4. Back curves within normal limits.
GOOD POSTURE
1. Head slightly forward.
2. Chest slightly lowered.
3. Lower abdomen in (but not flat)
4. Back curves slightly increased.
POOR POSTURE
1. Head forward.
2. Chest flat.
3. Abdomen relaxed (Part of body farthest forward.)
4. Back curves exaggerated.
BAD POSTURE
1. Head markedly forward.
2. Chest depressed (Sunken)
3. Abdomen completely relaxed and protuberant.
4. Back curves extremely exaggerated.
Children's Bureau, United States Department of Labor, Washington, D.C., 1926.

FIGURE 18

Gymnasium classes must incorporate good postural habits in their programs and continually stress this phase of physical education. Surely exercises can be performed with the body in good position as well as with the body in poor position. And the exercise program should be broad enough to habituate the individual for this position, with its improved alignment and function. It should also do the more important work of training the individual for better body function daily. Tricks and stunts are all right, but the goal should be that of better body function in everyday activities. It has been known for years that the flexor muscles of the body are used more than the extensor muscles. The gymnasium should have for one of its purposes the adjustment of flexor and extensor strengths so that the body will be balanced with greater ease and the expenditure of energy will be decreased.

Organic vigor must be developed and maintained. It is an outstanding fact that the majority of poor posture cases are found in those who are lacking in organic vigor. While it is true that some athletes possess poor body mechanics, it is also true that the individual who is well nourished, whose body is in good tone, etc., is far more likely to have good body mechanics than the one whose body is in poor tone and who is poorly developed.

V. THE CAUSES OF POOR BODY MECHANICS

A. General muscular insufficiency and organic inadequacy.
B. Incorrect postural habits.
C. Errors in general hygiene.
D. Injuries and deformities.
E. Defective reciprocal innervation of antagonistic muscles.
F. Miscellaneous causes.

The causes of poor body mechanics are found to overlap in almost every case. A boy with general body weakness finds his habitual poise colored by his feelings. He cares little whether he stands erect or whether he slouches. His errors in hygiene have no doubt contributed to his weakened condition. Thus no one cause can be taken as the main reason for the poor body mechanics. But for the sake of clearness the various causes are here discussed separately:

A. General Muscular Insufficiency and Organic Inadequacy [1]

The average poor body mechanics case shows *poor muscular development.* The muscles of the back are weak. The abdominal muscles are relaxed.

[1] See Jansen Murk, *Feebleness of Growth and Congenital Dwarfism,* Oxford Medical Publications, 1921.

The general muscular system is flabby. As the ideal body position demands, (*a*) a normal bony framework, (*b*) strong and properly balanced muscles, and (*c*) a normal functioning nervous system, this deficient muscular system makes it impossible for the individual to maintain a correct body position even though he may know how to balance his body correctly. Knowledge of body position without strength to maintain that position results in a temporary pose.

Sedentary workers find their bodies adapting themselves to existing environmental conditions. In one type of these individuals the flexor muscles receive some work, but the extensors are used very little. From constant sitting the pelvic obliquity is decreased, the upper part of the sacrum moves upward and backward, and the abdominal organs are thrust upon the pelvic organs. The abdominal muscles are relaxed, and the upper part of the body is tilted forward to maintain a semblance of balance. The entire body thus presents a picture of fatigue and senility.

Another type of sedentary worker shows a general slumping of the body in standing, a consequent depression of the ribs, and an interference with the function of the organs contained in the chest. The curves of the body are increased; the pelvic obliquity is increased; and the supporting structures of the various organs are weakened. Due to this general bodily weakness, the muscular system is in poor tone, and good posture is hard to maintain.

Undernourishment often causes general debility of the body and consequent poor body mechanics. A good posture group shows a greater number of well-nourished individuals than poorly nourished individuals. Thus undernourishment is, no doubt, a causative factor in poor body mechanics because of the difficulty which the body finds in maintaining a correct position when the body as a whole is weak and undernourished. It must not be assumed, however, that all poor body mechanics cases will show malnutrition.

Overwork and *fatigue* are often contributory causes of poor body mechanics. This fact is well demonstrated in the case of the schoolboy who is handicapped by some bodily defect and yet is trying to carry a heavy school program and do chores at home. The school task becomes disagreeable, and the body slumps. The sedentary character of the school program creates distaste for the entire school work, and the fatigue slouch often results. Physical activity in the school program aids in alleviating the feeling of ennui and results in lessened fatigue, greater enjoyment of the school work, and better body mechanics.

In work with women, it is not unusual to find one who has suddenly followed the dictates of Dame Fashion and has given up a long-standing habit of corset wearing. She finds herself suffering from constipation, backache and various pelvic disorders. For years her abdominal and lower back muscles have been relatively inactive. Now they find themselves suddenly

challenged to labor in a new and unaccustomed manner. They must actually assist in supporting the trunk and the abdominal viscera. Fatigue results, and poor body mechanics follows. Corsets cause atrophy of the abdominal muscles, and when corsets are to be permanently discarded, due preparation of the abdominal and lower back muscles is necessary if these muscles are to perform their new task of supporting the trunk and the abdominal viscera.

Illness and *infections* which cause a weakening of the body will result in a rapid onset of fatigue and the usual skeletal weakness and body slump. This slump causes a strain on the ligaments and muscles of the body, and further fatigue results. When the muscles and ligaments are thus overburdened, the strain is carried to the bony framework, and deformity follows. The sequence is obvious: when the muscles are fatigued, the ligaments must bear additional burdens; when the ligaments are overstretched, the bony framework is disintegrated. The individual who is weakened by illness or infection shows the usual slump posture. Defects of the nose and throat are found in many of the poor body mechanics cases. The individual who is recovering from a debilitating illness should be cautioned against fatigue and the effect of fatigue on the body mechanics. In many cases additional rest, rather than the regular exercise program, is ordered for these individuals.

Disturbances such as constipation, anemia, defective vision and hearing, diseased tonsils and enlarged adenoids, bronchitis and many of the so-called childhood diseases produce muscular weakness and general debility. Thus these disturbances must be considered as causative factors in the production of faulty body mechanics.

B. Incorrect Postural Habits

1. *Sitting.* The average person assumes a poor sitting position. The lower portion and a part of the middle portion of the spine are unsupported. The natural tendency is to round the entire back and protrude the head forward. Moreover, there is a "buckling at the middle" of the body and a decrease in the pelvic obliquity. In this position the body is allowed to slide down in the seat, rather than to be supported by the thighs and buttocks as when sitting up in a seat. See Figures 19 and 20.

The fault in many cases is with the chair. Many school desks and seats conform to the definition of the coffin: "The man who made it, didn't want it; the man who bought it didn't use it; and the man who used it, didn't have a thing to say about it." The seat which a child uses for any length of time should be correct in every detail. It should not be purchased simply because it "never will wear out." The desk should be slightly lower than the elbows when the child sits erect, and have a slant of fifteen degrees which will allow easy eye adjustment to the work which the child has to do.

FIGURE 19
Incorrect sitting

FIGURE 19-A
Incorrect sitting

FIGURE 20
Correct sitting

FIGURE 20-A
Correct sitting

Dr. Goldthwait has designed a special chair for rest and one for work.[1] Both are characterized by a shallow seat. The average chair seat is extended too far forward, thus causing pressure upon the nerves and blood vessels of the lower third of the under surface of the thigh. Dr. Goldthwait's chairs support the body on the tuberosities of the ischia and the upper third of the thigh. The rest chair permits the body to lean slightly backward and still maintain correct posture. The chair seat is tilted slightly higher in front than at the rear, thus making it possible for the body to maintain its good position without sliding forward on the seat. The work or desk chair seat drops a trifle below horizontal at the front edge and allows the body to bend forward from the hips and still maintain a comfortable and a correct posture.

In the proper sitting position the body should be comfortable. The bend should be from the hips and not at the waist. The proper pelvic tilt should be maintained, and the weight of the body borne on the ischia and upper third of the thigh. The lower back and buttocks rest comfortably against the lower back of the chair and the rear of the seat. The thighs are nearly horizontal, depending on whether the individual is at rest or at work, and the feet should be flat on the floor and parallel.

While a child is busy taking notes in school he forgets about the correct poise of the body and assumes what is commonly called the "fatigue slump." Day after day he repeats this performance until the slump position becomes habitual. With correct school furniture this tendency to slump is minimized. A slumping posture is possible, even in the correct seat, but if proper emphasis is laid on correct body mechanics and the correct seat is provided to assist in maintaining correct body mechanics the chances for correct body poise are greatly increased.

Badly directed light in the schoolroom and at home will cause a child to twist the body into that position which allows the light to strike his book more favorably. Those with defective vision will lean forward in an attempt to see more distinctly. These twisted positions are generally not correct poise. Care must be exercised to avoid incorrect lighting conditions. Defective vision should be treated by an oculist, and the child given the most favorable seat in the schoolroom to prevent further eye strain.

Bad habits in sitting are more liable to become permanent because of the long periods spent in one position. If the position is poor, the poor posture is maintained over a considerable length of time. Many children (especially girls) sit with one foot curled under them. This position tilts the pelvis to one side and is likely to develop a faulty posture in the lateral plane. If the faulty position is continued for a considerable number of

[1] Goldthwait, Joel E., "The Importance of Correct Furniture to Assist in the Best Body Function," *Jour. of Bone and Joint Surgery*, 5:179-84, April, 1923.

months there is a very good possibility that lateral curvature of the spine will develop from this pose.

The sitting posture must be correct. Due to the inactivity of this position, a person sitting for any length of time often becomes restless and is very apt to slouch into a poor posture. In the standing position there is an increase of muscle balance activity which prevents the severe slump often seen in the poor sitting position. School children who are forced to sit for over one-half hour at a time usually slump into a poor position which causes fatigue of the undeveloped muscles and irregular compression of the growing bones. Short periods of relief, in the form of definite stretching exercises, will tend to offset the bad effects of prolonged sitting.

2. *Standing.* Standing in good position is not so tiresome as standing in poor position. Thus, since the majority of people do not stand correctly, they tire quickly and allow their bodies to slump when fatigue of the supporting muscles begins to manifest itself. A person who is tired from standing naturally slumps the weight of the body over the right hip and right leg. The left leg is not bearing its share of the burden, and the spine is curved to the left side (convexity left). This is a postural curvature which results from the body's following the line of least resistance. The right hip is very prominent and the right shoulder is lower than the left shoulder. The body seems to "hang" in this dejected position. Accompanying this condition in boys is the bad habit of thrusting the hands in the side pockets of the trousers. A contracted chest usually results. More stress should be laid upon the necessity for correct standing. And surely the functional efficiency and the lessened fatigue factors which accompany good body mechanics are more important than the æsthetic factor.

3. *Walking.* Good walking is conducive to good body mechanics. But the ordinary walk can hardly be called a walk. It might better be termed a "shuffle." The common walk which causes faulty body mechanics is the one in which the individual shuffles along, with his head thrust forward, his chest depressed, his feet turned outward and his entire body presenting a picture of abject fatigue. When the head is erect and the chest is held high and the entire body is in balance, walking can be an ideal exercise for the development and the maintenance of correct body mechanics.

4. *Lying.* Sleeping always on one side of the body is often productive of incorrect posture. The hips and shoulders are the points of support of the trunk. The mobile lumbar spine is allowed to sag. A person with a lateral curvature of the spine (children up to puberty excepted) often assumes a sleeping position which exaggerates this curve, for example, a person with a right dorsal curve (convexity right) often sleeps on the left side of his body. This position allows the lumbar segment to sag to the left and tends to develop a compound curve. Since sleep generally occupies one-third of our

time, surely it is wise to avoid a sleeping posture which will increase the spinal deformity. In cases of lateral curvature it is much better to lie on the back.

Reading in bed is injurious to the eyes and to the mechanics of the body. The reading posture is generally the same each time the offense is committed. If the light is on the left side of the bed the reading position is usually on the left side. Besides injuring the eyes this posture causes a continuous stretching of the muscles and ligaments on the left side of the body. A further point to be considered in connection with this question of reading in bed is the fact that the position is assumed after the day's work is over and the body is somewhat fatigued. Due to this general fatigue, the ligaments and muscles offer little resistance to the poor body position, and a marked curvature of the spine is evident.

5. *Occupations.* Occupations which require the individual to assume a faulty body position are not uncommon. The rounded back of the ditch digger, the lateral curvature of the newsboy and the stooped shoulders of the bookkeeper are familiar to the reader. These occupations must be combated by suitable corrective exercises which will offset the faulty occupational positions.

The school child is especially prone to postural disturbances. Carrying books back and forth to school is not conducive to correct body mechanics. In the first place the task is not an agreeable one; in the second place the books are usually carried in a position which causes faulty carriage. One child carries his books under the right arm, another carries his books under the left arm. Neither makes any attempt to distribute the weight equally, and definite faulty carriage results. A child whose body is well developed will be in little danger of this temporary faulty posture, but, on the other hand, a child who is poorly developed is not quite strong enough to resist the bad effects of carrying school books on one side of the body, and consequently develops poor posture.

Being a "student" should not be conducive to faulty body mechanics if suitable preventive measures are enforced. Statistics show that the curve of good posture is downward from the first grade while the poor posture curve ascends from the first grade up. This means that stricter preventive measures should be enforced in order that bad effects from bodily weakness and improper postural habits may be minimized.

C. Errors in General Hygiene

It must be recognized that many of the causes of poor body mechanics which have been discussed could well be classed as errors in hygiene. There are indeed some outstanding hygienic errors which are productive of poor body mechanics.

1. *The Neglect of the "Rules of the Game."* These rules have been compiled by the American Child Health Association and are as follows:

a. Taking a full bath more than once a week.
b. Brushing the teeth at least once a day.
c. Sleeping long hours with windows open.
d. Drinking as much milk as possible, but not tea or coffee.
e. Eating some vegetable or fruit every day.
f. Drinking at least four glasses of water a day.
g. Playing part of every day out of doors.
h. Having a bowel movement every morning.

2. *Failure to Have a Periodic Health Examination at Least Once Each Year.* The average parent does not realize that his child is deformed until the deformity becomes pronounced. A periodic health examination often reveals slight defects and deformities which might soon become serious, but which will yield to treatment readily.

3. *Failure to Follow the Advice Received at the Periodic Health Examination.* Diseased tonsils are serious menaces to health. If the doctor notes this condition at the periodic examination and advises the removal of the tonsils, his advice should be followed at once.

4. *Nervous Tension.* The average child's day is filled with hustle and hurry. If he has retired late he is reluctant to arise in the morning. He hurries his breakfast in order that he may not be tardy at school. His school program demands a heavy expenditure of mental work and physical work. After school is dismissed, music lessons, homework, dancing classes or other activities keep the child occupied until evening. And a visit to the moving pictures in the evening completes the day. Is it any wonder that the child is nervous? Rest, relaxation and recreation are needed in the above case.

5. *Improperly Fitted Clothing.* This tends to distort the body posture. The average "ready-to-wear" suit will not fit the child when he stands in an erect position. Heavy coats drag the shoulders down and depress the chest. Straps which pull on the points of the shoulders cause a slumping of the trunk and a disturbance of body balance. Tight garters restrict circulation and cause consequent fatigue. Ill-fitting girdles and garter supports pull the body into a poor position. Shoes of poor shape and improperly fitting shoes cause foot disturbances and fatigue which are productive of faulty body mechanics. Ill-fitting clothes make it difficult for the wearer to maintain a correct body poise. Moreover, the fashion magazines do positive harm by picturing the "stylish slouch" and thus setting up a false standard of values for the young girl to follow. They add to all the unconscious hygienic errors one that is consciously tolerated and even sought. Good body

mechanics should be made possible with the least amount of difficulty. If the body wears properly fitted garments, it has one less obstacle with which to contend in its efforts to maintain good body mechanics.

The hygiene errors noted above are by no means the only ones which tend to make good body mechanics difficult, but they are the most common. Parents should recognize that their task of "bringing up children" demands study and careful application of educational principles. They should see that common hygienic laws are obeyed by the child. They should themselves be good examples of health; they should teach hygiene by example and not entirely by precept. Good coöperation on the part of the parents gives the children sufficient knowledge and practice of health habits to enable them to offset many of the diseases and defects which generally undermine health and cause faulty body mechanics.

D. Injuries and Deformities Causing Faulty Body Mechanics

1. Injuries which necessitate a shifting of the body weight are almost certain to result in faulty body mechanics. Thus a hip injury or an osteomyelitis with a shortening of one leg will produce a lateral curvature of the spine. A strained foot will often initiate the habit of bearing the weight on the foot which is not strained, and even after the strain has been relieved, the habits may continue.

2. Deformities following infantile paralysis and tuberculosis of the spine are usually conducive to incorrect body mechanics. Proper bracing and the use of artificial supports, as recommended by the orthopædic surgeon, are the essential requirements for correction of these deformities, where correction is possible.

3. Rickets start many children off in early life with a weak bony structure, for this disease causes unsound bone tissue. If these children bear their weights with their bodies in poor positions severe deformities often result.

4. Anatomical defects such as a cervical rib, an asymmetrical sacralization, embryological maldevelopment of the vertebræ, etc., must be considered as deforming factors. The relief of these conditions is rarely within the power of the physical educator.

E. Defective Reciprocal Innervation of Antagonistic Muscles and Deficient Reflex Tonic Muscular Activity

In the first year of the life of the child the foot posture is one of abduction and flat feet. According to Bankart this position is due to the fact that postural activity has not yet been developed in the child.[1] When this reflex

[1] Bankart, A. S. B., "Postural or So-called Static Deformities," *British Medical Journal,* p. 587, April, 1921.

mechanism does develop, the feet are adducted and the arches are raised.

The nervous mechanism of the body is not so thoroughly understood as many writers would have us believe. Let us take two normal people affected by the action of gravity. One body is erect and the other is slumped. Apparently the action of gravity alone cannot explain the erect position of one and the slump of the other. There must be something deeper in the cause of the slump posture. According to Sherrington the position of the body is maintained by continuous reflex muscular activity.[1] Thus the slump posture may be explained by saying that the normal mechanism, which should counteract the influence of gravity and keep the body in an erect position, has failed.

Although exact details are lacking, there is sufficient clinical evidence to prove that a nervous mechanism is connected in some way with our daily actions. Without thought on our part we walk along the street and unconsciously counteract the effect of gravity and maintain the body in an erect position. In the normal individual the reciprocal innervation of the antagonistic muscles results in a "lengthening" and "shortening" action in the postural muscles. This counteracts the effects of gravity and maintains the body in an erect position without undue tension or strain. Thus the habitual subconscious state of reflex activity permits an erect posture. Infantile paralysis, being an affection of the anterior horn of the spinal column, shows a distinct interference with the reciprocal innervation of the motor nerves.

Arnold[2] has written of the importance of the labyrinth in maintaining correct posture. As we learn more of the inner workings of the body, we will learn more of this factor which has an important bearing on the body posture. Sherrington explains the labyrinth as the thing which keeps the world right side up for the organism by keeping the organism right side up to its external world.[3] A blow on the point of the jaw interferes with the functioning of the labyrinth, and causes the recipient to fall unconscious to the ground. Thus, although this reciprocal innervation and labyrinth factor is not fully developed as yet, it behooves the reader to consider the possibilities of a close correlation between this factor and body mechanics.

F. Miscellaneous Causes of Poor Body Mechanics

1. *Rapid Growth.* During the childhood and especially during the adolescent period, rapid growth of the child demands careful attention to

[1] Sherrington, C. S., "Postural Activity of Muscle and Nerve," *Brain,* 38:19, 1915.

[2] Arnold, E. H., "Posture in the Light of Science," *Amn. Phy. Educ. Rev.,* 28:361-5, October, 1923.

[3] Sherrington, C. S., *The Integrative Action of the Nervous System,* Yale University Press. See Lowman C. L., "The Effect of Faulty Skeletal Alignment Upon the Eyes," *Amn. Jour. of Orthopœdic Surgery,* Vol. 16, No. 12, pp. 459-492, December, 1918.

the development of correct postural habits. Proper muscle balance and muscle sense must be developed to insure, other things being equal, a correct body poise.

2. *Emotional States.* The close relationship between the mental and the physical side of life is shown in the poor body tone and general depression of a person suffering from either melancholy or worry. "Posture expresses personality." The person who is cheerful is more likely to show good body mechanics than the one who is melancholy.

3. *Heavy Breasts.* Lowman [1] gives a very clear description of the postural deformities which accompany heavy pendulous breasts. These heavy breasts are found in thin as well as in heavy individuals. "Improper brassieres, tight binding, etc., influence both the breasts and the shoulder girdles." Dr. Lowman has devised a garment which supports and corrects these pendulous breasts without producing atrophy or irritation.

4. *Any one type of sport carried to excess, at the expense of body mechanics.* Many boxers, leading with their left hands, present distinct lateral curvatures of the spine (left convexity). The elevating of the left hand above the shoulder in fencing gives the fencing master a typical posture of lateral curvature to the left. Canoeing, since it is usually more proficiently done with the right hand higher than the left, is conducive to right lateral curvature. The linemen in football are in a crouched position which, despite the excellent development of their bodies, results in a tightening of the chest muscles and a lengthening of the back muscles. If no other type of exercise is given to shorten the back muscles and stretch the chest muscles, a distinct slump may be noted.

It must not be inferred that the writer is advising against these activities. On the contrary, he advises their continuance but with an equalization in the way of counter activities which will offset the poor postural effects of the sports and maintain a balanced posture. Backstroke swimming or breaststroke swimming is ideal for stretching the shortened pectorals and shortening the stretched back muscles. Tennis for the boxer and the fencer will raise the right shoulder. As canoeing is generally supplemented by swimming and other vigorous outdoor activities, there is little danger of severe postural disturbance from this sport. It is urged, however, that the stroke should not exaggerate any existing postural curve, but should tend to correct any existing lateral curvature. Thus in cases of left lateral curvature, the stroke should be on the left side of the body and thus raise the right shoulder and shorten the overstretched muscles on the left side.

[1] Lowman, C. L., "Heavy Breasts as a Factor in the Production of Faulty Posture," *Jour. A.M.A.*, 78:173-5, January 21, 1922.

VI. THE EFFECTS OF POOR BODY MECHANICS

A. Impaired Organic Function.
B. Impaired Efficiency of the Body in General.
C. Poor Appearance, from the Æsthetic Point of View.

A. Impaired Organic Function

When the body is in *good* position, the entire organism is in "balance." The various organs of the body are held in positions which allow them to function most efficiently and with the least amount of strain. From an anatomical point of view we may be quadrupeds set on end but "balance" in this erect position in which we now find ourselves implies organic efficiency. If the anatomical integrity of the erect position is preserved, the functional efficiency of the organs is as near normal as mechanical arrangement in the erect position will allow it to be. In the well-poised body the head is erect; the antero-posterior depth of the chest is as great as is possible without strain; the thoracic cavity is sufficiently large to allow the lungs and the heart to function efficiently; the diaphragm is high and deep excursions of this muscle are possible; the liver is well supported by its ligamentous attachment to the diaphragm; the kidneys are well supported by their respective shelves of retroperitoneal fat, muscles and fascia; the flat abdomen gives good support of the abdominal organs which lie directly posterior to the anterior abdominal wall; and the normal physiological curves are not exaggerated.

While poor posture was being treated because it was unattractive, Dr. Goldthwait and other physicians were attacking the poor posture problem because of the effect of this condition on the health of the individual. Dr. Goldthwait's splendid article on the relation of posture to human efficiency, and many other articles which have followed it, point conclusively to a definite relationship between faulty body mechanics and impaired organic function.

When the body is in poor mechanical position, the organism is not in anatomical balance and consequently cannot be expected to manifest perfect organic function. The first derangement of importance is the lessened antero-posterior depth of the thorax. This causes impairment in the action of the lungs and to a certain extent, of the heart also. Though this may be of little consequence in a body which is not further impaired in a pathological way, yet in cases of diseased organisms, even slight impairment of heart action is likely to be more serious. The heart in these cases was already working harder than normally to combat the pathological condition, and when a lessened chest depth further interferes with its action,

the ability of the heart is definitely impaired. The diaphragm, in the ordinary case of poor body mechanics, is much lower in the standing position than in the lying position a condition which results in smaller diaphragmatic excursions. The liver, kidneys, spleen and abdominal organs are not given proper support, and their function suffers a distinct interference. The digestive processes function poorly when the tone of the intestinal muscle fibers is poor Lordotic albuminuria is often present in cases where the back is extremely hollowed. Also, due to the hollow back position, the abdominal muscles being relaxed fail to give proper support to the abdominal organs—as these organs rest against the anterior wall of the abdomen. In cases of visceroptosis there seems to be a direct relationship between poor posture and ill-health. In the flat back posture the abdominal organs are thrust heavily upon the pelvic viscera.

Thus in faulty skeletal alignment the organs of the body are working at a disadvantage and their normal growth and development is hindered. Thus many cases of poor body mechanics show organic insufficiency. On the other hand, improvement in balance alignment results in better functioning of heart, lungs and abdominal organs and in the arresting of active joint symptoms.

Poor body mechanics often develops during the rapid growth period of adolescence. The abdominal organs increase in size during this period and, if skeletal alignment and organic vigor are not maintained, these organs pull on their mesenteric attachments at the spine, and the spinal column and head are pulled forward. Undue fatigue, occupations which distort the body, infections, etc., should be carefully avoided during the adolescent period. Special attention to organic vigor and good body mechanics during this time will, in a large measure, insure good carriage in adult life.

B. Impaired Efficiency of the Body as a Whole

There is a distinct correlation between poor body mechanics and lessened vitality. The burden of proof points to the fact that poor body mechanics is a sign or symptom of physical or mental depression. There is, on the other side, suitable proof that improper skeletal alignment causes the body to work at a mechanical disadvantage. To be sure, a normal individual suffers very little *observable* inconvenience from temporary faulty body mechanics; but an individual whose resistance is lowered by fatigue, infection, etc., and who habitually uses his body at a mechanical disadvantage can not be considered healthy. His faulty posture further impairs the efficiency of the unhealthy body, and definite observable ill-health ensues.

The body must be considered as a machine. If all parts of a machine are in perfect alignment, greater efficiency is possible than if the parts were not properly aligned. Faulty body mechanics, or faulty alignment, results

in wasted energy. The body is strained from the head down through the feet. The body is not functioning as efficiently as it could function if it were properly aligned, or, in other words, if it were in a position of skeletal alignment.

The relation of improper body balance to lessened bodily efficiency is not generally appreciated by the average person. Many are working their bodies by sheer nervous energy, because the physical side is handicapped by various minor ailments and deformities. Poor body mechanics must be considered as one of the minor ailments which wastes energy, saps vitality, and predisposes the individual to further bodily ills. The obese individual, who maintains balance by leaning back from the waist, hollows the back and thrusts the abdomen forward. This position causes a strain in the lower back and often results in sacro-iliac and other lower back disturbances. The individual who abducts his feet throws a strain on the entire body as his balance mechanism attempts to preserve the erect position. Good body mechanics means correct anatomical position. This allows for the best possible functioning of the vital organs. Lordotic albuminuria, constipation, and other ailments of like nature are often relieved when the poor body mechanics position has been corrected. When the vital organs are functioning efficiently and the parts of the body are correctly aligned, the efficiency of the body is at its highest level.

Unfortunately many people wait until outstanding symptoms of ill-health make them aware that their systems need attention. Pains in the feet, legs and back are generally spoken of as "rheumatic pains." Many run the patent medicine gauntlet in an attempt to cure their "rheumatism"; only after fruitless attempts to secure relief do they seek the advice of a doctor. Years of faulty posture may have elapsed before this medical assistance is sought, and during these years the resistance has been lowered and a pathological condition may have developed. Furthermore, the treatment of the pathological condition brings only temporary relief unless the body mechanics is corrected.

While faulty body mechanics may not be the specific cause of the condition of ill-health, it must be considered as a causative factor. Faulty body mechanics interferes with the function of the vital organs. This means that the energy-producing mechanism is not functioning efficiently. The faulty body balance position causes extra energy to be expended in maintaining the erect position. The energy-producing mechanism is not keeping pace with the energy expenditure. Fatigue and increased faulty body mechanics results. Correction of body balance gives nature an opportunity to expend more energy in overcoming bodily defects and ill-health.

In work with children it is important to note that the majority of cases of physical and mental defects show poor body poise. The individuals with

good body mechanics comprise the greater proportion of the students who are rated high in attendance, deportment, scholastic standing, physical vigor, etc. In business to-day a man's mental and physical energy and alertness are portrayed largely in his posture. The majority of successful men show better skeletal alignment than the average mediocre individual. The "personal presence" which comes from correct body balance means mental poise and physical ability. Body mechanics colors one's feelings. Depression is portrayed by the loss of tone throughout the body. With poor body mechanics a large part of the nervous and physical energy which is needed for everyday activities is simply thrown away without profit.

Notwithstanding the fact that there are many athletes in a condition of poor skeletal alignment, the greater number of athletes rate higher in skeletal alignment than the non-athlete. This should give the average coach food for thought. The skilled athlete has control of his body. He moves with grace and poise. With very few exceptions the skilled athlete has a good or very good posture. The youngster who has aspirations along athletic lines should be informed of the necessity for control of the body mechanism. A well-poised body is one which is in balance; the position of correct body carriage is one of poise and balance. Thus for athletic reasons alone care should be exercised to see that correct body mechanics sense of muscle balance is developed so early in the life of the child that when he reaches high school or college, he will have a body which is under his control. Guidance to correct body mechanics in the elementary school years will insure a greater number of well-poised, skillful performers in high school and college.

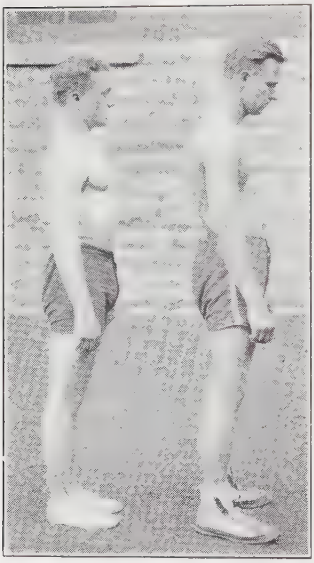
C. Poor Appearance, from the Æsthetic Point of View

Despite the fact that the appearance of an individual is not the most important factor in poor body mechanics, it must be given due consideration as it does have potent influence. It is an accepted fact that the individual who holds his body in a slouch position is not as pleasing to the eye as one who has an erect, dynamic carriage. The "débutante slouch" and the spineless carriage of many high school and college girls and boys is not considered good form by the majority. A stigma is gradually being attached to the sheik type of college male; the derisive name of "Cake Eater" is not pleasing to his ears. Personal attractiveness is measured by good, rather than bad, carriage. The youthful appearance of the woman with good carriage is appealing to all. Gowns are displayed to much better advantage on a woman or girl with good carriage. Art pictures the finest types not in the "débutante slouch" or fatigue pose but in good carriage and perfect bearing. Whenever this appeal, on the basis of the æsthetic factor, can be used it is a worthwhile stimulus.

VII. TYPES OF FAULTY BODY MECHANICS

(Non-pathological, unless otherwise indicated.)

Although a classification is offered, in an attempt to designate the various types of faulty body mechanics, it must not be inferred that these types occur singly except in a very few cases. One curve is compensated by another curve. Various authors have presented classifications which are not generally accepted. The following classification is offered with a realization that the antero-posterior classification is still subject to debate.



A. B.

FIGURE 21

A. Good posture.
B. Fatigue slump.

A. ANTERO-POSTERIOR CURVES.

1. *Fatigue Postures.*
   a. Round shoulders, or round upper back or stoop shoulders.
   b. Round back.
   c. Flat back.
   d. Hollow back.
   e. Round-hollow back.
2. *Hypertonicity Posture.*
   a. Bantam.

B. LATERAL CURVATURES.

1. *Postural.*
2. *Structural.*

(See Chapter V, p. 145.)

The term "*Antero-posterior curve*" is used to describe the cervical forward curve, the dorsal backward curve, and the lumbar forward curve. An exaggeration or an obliteration of any one of these curves presents an abnormal condition which is more specifically named according to the particular part of the spine involved; for example, stoop shoulders would involve an exaggeration of the dorsal curve and a diminishing of the cervical curve. It seldom happens that any one of the exaggerated antero-posterior curves occurs singly. The faulty balance which one curve causes must be compensated by another antero-posterior curve; for example, in the case of stoop shoulders the head is thrust forward and the upper back is unduly rounded. This position necessitates a shifting forward of the lower segment of the trunk and a hollowing of the back.

A B C D E

FIGURE 21-A

Five high school boys

A. Bantam.
B. Round back.
C. Lordosis.
D. Normal (but thin).
E. Normal.

A. B. C. D. E. F.

FIGURE 21-B

A. Round hollow back.
B. Round shoulders.
C. Round hollow back.
D. Round hollow back.
E. Round shoulders.
F. Round hollow back.

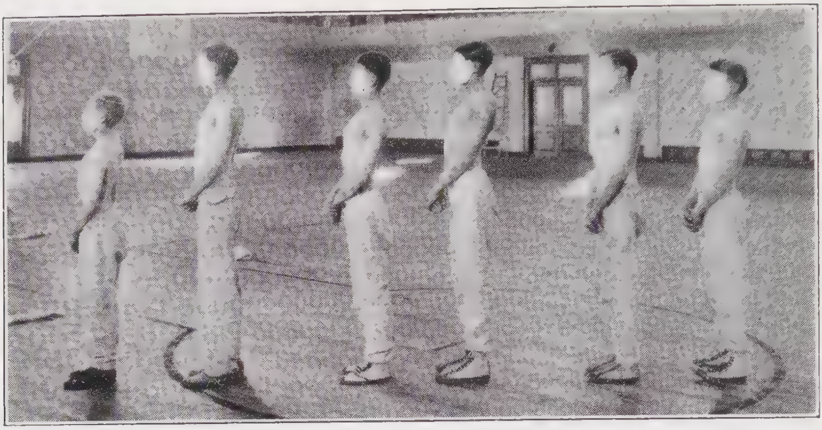


FIGURE 21-c

Same as Figure 21-b—but with voluntary correction (Students were told to "stand as well as you can")

1. Fatigue Posture

This name has been chosen to describe the many types of faulty body attitudes which present as their outstanding characteristic an atonic or asthenic appearance. One or more of the physiological curves are increased, or the lower back curve may be obliterated as in the flat back type. The abdomen is usually protuberant and the feet are often weak. In many cases the feet are flat. The general muscular development in the fatigue posture individual is poor. He lacks vigor and poise. He looks, and often is, tired.

A great number of younger children who present these conditions show marked muscular insufficiencies. They can correct their condition voluntarily or the teacher can correct the condition by slight pressure on the over-stretched parts, but they lack the necessary strength and balance sense to maintain the corrected position. The habitual posture is one which allows the body to slump. In older individuals, and in some children, the faulty position is of such long duration that the change in the function of the bone has been attended by definite alterations in the internal structure of the bone (Wolff's law).[1] This latter type of case is resistant to correction.

a. *Round Shoulders, Round Upper Back or Stoop Shoulders.*

For convenience the term "round shoulders" will be used exclusively for the type of case which accompanies all the fatigue postures under "a." Strictly speaking, this condition is one in which the curve in the upper dorsal

[1] Whitman, R., *Orthopædic Surgery,* p. 229 (Sixth Edition), Lea and Febiger Co., 1919.

spine is increased, and the head is thrust forward, decreasing the anterior cervical curve. In slight cases the scapulæ are drawn away from the back at the inferior angles; in marked cases of round shoulders the scapulæ are drawn away from the back at the inferior angles and the inner borders, presenting the characteristic picture of "winged scapulæ." The round-shouldered individual's shoulders are drawn forward, his chest is depressed, and consequently, his respiratory efficiency is lowered. His abdomen is usually protuberant. But this protuberance is not the same as that found in the obese individual. In the round shoulder case the abdomen is lowered (ptosis), the greatest protuberancy being directly anterior to the upper front angle of the hip bone (anterior superior spine of the ilium). The lower back curve may be unchanged, though it often presents a hollow back and, in a few cases, a flat back.

b. *Round Back* (generally termed "Kyphosis").

By the term "round back" is meant a drooping or relaxation of the entire back backwards. The dorsal spine makes a continuous exaggerated curve backward often involving the upper lumbar vertebræ. In a case with heavy gluteal muscles, this is often incorrectly diagnosed as "Kypho-lordosis" or "round hollow back." The head is not thrust so far forward as in the case of round shoulders. The general slouch of the body is evident.

c. *Flat Back* (the lumbar curve is obliterated).

Earlier writers laid greater stress on the flat back than on the hollow back. Dr. Goldthwait [1] emphasized the pressure of the abdominal viscera on the pelvic viscera in this position. The forward position of the upper trunk and the consequent displacement of the viscera are thoroughly described in his 1909 article. Bowen and McKenzie [2] refer to this posture as the "Gorilla Type." But this flat back condition is more prevalent in older people (especially women) than in students and children. If the cases of faulty body mechanics are considered as a whole to-day, the number of flat back cases in younger individuals is almost negligible. Current writings give little space to the flat back cases.

The flat back type is characterized by the fatigue slump of the entire body and a definite forward thrust of the shoulder girdle. With the exception of the flat lumbar curve the picture is not very different from that of the round shoulder case.

A word of caution should be given in the matter of prescribing exercises for faulty antero-posterior curves. In some cases the old-style teaching to correct flat back conditions led to a distinct overstressing of the forward

[1] Goldthwait, Joel, "The Relation of Posture to Human Efficiency," *Amn. Jour. of Orthopædic Surg.*, 7:372, 1909.

[2] Bowen and McKenzie, *Applied Anatomy and Kinesiology*, p. 254, Lea and Febiger Co., 1919.

inclination of the pelvis. The exercises should be fitted to the individual and not given in a "blanket prescription" manner which lays undue emphasis on correcting the minority condition of flat back posture. A superficial examination of an average group of young students (boys, girls, young men and young women) will disclose the flat back in only a very few individuals while the round shoulders, round back, hollow back, and combinations of them will predominate.

d. *Hollow Back* (Lordosis).

The attention to-day, while still directed to existing flat back conditions, is focused more on the correction of the increased (over 60 degrees) pelvic inclination which is found in *hollow back* individuals. Goldthwait [1] in *Body Mechanics and Health* (1922 publication) gives little space to the flat conditions. He emphasizes very strongly, however, the need for correcting the hollow back and decreasing the exaggerated tilt of the pelvis to the normal tilt of 60 degrees. The hollow back condition does not, for obvious reasons, occur without compensating curves in the upper spine. And many of the hollow back cases present also a problem of incorrect muscle training (discussed under "Bantum Posture") as well as the fatigue slump.

e. *Round-hollow Back* (Kypho-lordosis).

An examination of the average group of students will reveal more round-hollow backs than any other type of antero-posterior defects. It is a definite fatigue slump position. The head is first dropped forward and the shoulders rounded. This position causes a depression of the chest. The abdomen is then allowed to sag in an unconscious effort to keep the body in the upright position. Some cases have their beginnings in a relaxed abdomen and a hollow back, and this condition is naturally compensated by the forward thrust of the head and the rounding of the upper back.

2. Hypertonicity Posture

a. *Bantam Type.*

It must be understood at the beginning of the discussion on bantam postures that this hypertonicity condition is found in many of the fatigue posture types. The hollow back often presents a condition in which the erector spinæ muscles of the lower back are unduly shortened and the abdominal muscles are lengthened. Both groups may present relatively good tone. The stiff position of "Attention" as seen in many gymnasium classes and in the army is productive of the backward thrust of the shoulders with a compensating thrust forward of the head and lumbar spine.

With the more intelligent understanding of body mechanics the old command of "Shoulders back!" should not be heard to-day. The West Point

[1] Goldthwait and Thomas, *Body Mechanics and Health,* Houghton Mifflin Co., Boston, 1922.

"Plebe" is reminded very often, however, by upper classmen that he is "in the army now." He throws his shoulders back, draws his chin in, flattens his abdomen, and stiffens his figure until actual strain results. A year of this vigorous discipline often establishes a posture habit which continues throughout life. Many army officers, who at middle age have not retained their erect army figure, show a marked lordosis.

The schoolboy who is admonished by his well-meaning parents to keep his shoulders back often presents a problem for the corrective department when he reaches college. He has developed a strained position of the body. His back is hollowed and, although his shoulders are thrown back, his head is thrust forward. Miss Bancroft has written of the abnormal protrusion of the head which results from overcorrection of poor posture.[1] This overcorrection leads to a stiffened "Bantam" posture which is faulty and fatiguing.

VIII. SYMPTOMS OF FAULTY BODY MECHANICS

1. Fatigue Attitude

The outstanding symptom of faulty body mechanics is the characteristic atonic or fatigue attitude. This is present in all but the hypertonic group or "bantam" type. Bodily defects and disease are naturally contributory causes (if not direct causes) of the fatigue attitude. Therefore disease and defect symptoms must be considered as usually being present in faulty body mechanics. The fatigue attitude is seen in the slump posture. The body does not line up with a perpendicular. The weight is not distributed in line with the perpendicular axis. The various parts of the body are deviated from their normal position, and the deviations are named according to the body parts involved, *e.g.*, round shoulders, etc.

2. Height Is Decreased

This is noted when the individual is asked to stand as tall as possible; generally the body height increases then from one to two or more inches. This ptosis or dropping downward of the visceral organs is descriptive of the giving way of the body to gravity. Dr. Crampton has written extensively on this "Skeletal or Visceral Ptosis." This is avoided when the reflex nervous mechanism and muscle tone are normal.

3. Flexibility Is Lessened

This condition occurs in the joints especially but may be seen also in the inability to correct poor position in cases of long standing where the

[1] Bancroft, J. H., *The Posture of School Children,* Macmillan Co., New York, 1920.

internal structure of the bones has been affected. The Danish gymnastic system[1] as it is practiced in this country has a great deal to offer in this matter of flexibility. It must be recognized, however, that flexibility without strength to maintain the more flexible posture often accentuates the deformity when fatigue prevents the muscles and nervous mechanism from properly balancing the structure.

4. The Muscles Are Poorly Developed

This fact is true in all but the hypertonicity group. The fatigue posture type does not possess the muscular tone and firmness of tissues which are found in the normal individual.

5. Muscle and Joint "Sense" Becomes Deficient

When this faculty is functioning properly, we are aware of our poor body mechanics position. When this faculty is deficient we are comfortable in and often unaware of the poor position of the body. Consequently, this poor position becomes habitual.

6. There Is a Lack of Physiologically Balanced Power in Opposing Muscle Groups

This results in a gradual shortening of one group (usually the flexors) and a stretching and weakening of the extensors. The condition is best illustrated in the case of round shoulders. The pectoral and other chest muscles are shortened, and the back muscles are overstretched and weakened.

IX. EXAMINATION FOR FAULTY BODY MECHANICS

All examinations for faulty body mechanics should be conducted in connection with the regular medical examination, or at least with a knowledge of the general health of the individual as revealed by a very recent complete medical examination. (For a complete medical examination the reader is referred to the *Manual of Suggestions for the Conduct of "Periodic Examinations" of Apparently Healthy Persons.* This manual is published by the press of the American Medical Association, Chicago, Illinois.) The general examination is essential for two reasons.

a. Body mechanics is not a local condition. The condition of the entire body must be considered in treating it.

b. Pathological conditions may be mistaken for unpathological faulty body mechanics. Examination prevents this error.

[1] Bukh, Niels, *Primary Gymnastics,* p. 132, E. P. Dutton & Co., New York, 1926.

This last point may be illustrated by the case which prevents any exaggeration of the spinal curve with a history of pain, spasm or stiffness. Pott's disease, or tuberculosis of the spine, presents this gradual bowing of the spine with pain and tenderness. Cases of a pathological nature are not subjects for corrective exercises. They should be sent immediately to an orthopædic surgeon. Any arrested tubercular condition, for which the physician has recommended exercise, should be very carefully watched, and if pain develops or stiffness increases, the exercise should be stopped. (The university classes often have one or more cases which show histories of Pott's disease in years past.)

A review of "types" and "symptoms" of faulty body mechanics will give one a clear idea of what must be looked for in the examination for Body Mechanics. The normal "landmarks" for the gravity line should be noted (1. Mastoid process; 2. Seventh cervical vertebra; 3. Fifth lumbar vertebra; 4. Head of great trochanter; 5. Head of fibula and 6. Tarsal scaphoid bones of feet.) With these facts in mind the examiner has before him also a clear picture of what good posture is. (See charts, page 63.) A poster, showing the good and poor types of body mechanics, may be hung in a convenient place in the examining room. Besides being of assistance to the examiner it will give the student a concrete guide on body mechanics.

The attire of the student to be examined and the arrangement of the examining room are of importance. The student should be stripped. Where there is unusually strong objection to this procedure, the limbs should be bare up to the knees and the trunk exposed above the level of the hips. When it is possible to have the student stripped, a fresh sheet may be girdled about the body for the sake of preventing any embarrassment. The best arrangement is an examining gown, ¾ length, open in back, with no sleeves. The examining room should be heated to 75 degrees F., and should supply suitable light in order that the examiner may observe accurately slight deviations from normal. An ordinary treatment or massage table completes the outfit of the examining room.

"What system of body mechanics examination shall I use?" is a much repeated question to-day. The average physical educator and health worker desires a cut-and-dried system which he can apply to his particular situation, but unfortunately it is difficult to provide this tested system which will fit all cases. In order that the reader may more intelligently choose the system which is most feasible for his community a number of them will be discussed.

Bancroft Vertical Test. When a line is dropped from the front of the ear to the forward part of the foot, the straight or zigzag lines (depending on the alignment of the student who is being treated) of the body are compared with the straight line. An ordinary window pole will serve the purpose of the vertical line. This examination includes all but the definite

droop of the shoulders. Thus an evaluation of the shoulder posture may be made by inspection. Bancroft gives the [illegible] of the shoulder position as follows: "If the neck be erect, the middle of the rounded tip of the shoulder should be back of the forward border of the ear. This may be called the ear test for the shoulders."

The chief objection to the use of this test is that the student realizes that he is "on trial" and he attempts to measure up to the best of his ability, even though his habitual standing position is very faulty. To be sure, there are many arguments in favor of this "temporary measuring up to what one can do," etc., but the fact remains that students do pose for their posture tests and these poses should not be regarded as their habitual standing positions. Where a test of this nature is used, there should be two grades:

1. The test posture.
2. The habitual posture. This may be rated when the student is unaware that he is being tested.

The Michigan public schools report a system which has a double rating. Pupils are graded "A," "B," "C," "D," or "E" for a posture test and "1," "2," "3," "4," or "5" for habitual posture. The pupil must first know what good body mechanics means if he is to pass a satisfactory test, and then he must habitually carry himself in a good position. Thus a pupil might receive an "A" on the "pose" test and a "5" on the habitual standing. This would mark him as one who knew what good posture meant but failed to practice good posture. Thus "A1" marks the ideal body mechanics [illegible] to receive a good grade.

Bancroft's Triple Test. This appreciates the possibility of the "pose" posture. The triple test, which eliminates the pose, is as follows:

1. Standing Test. By individual or class inspection by the teacher, a process of elimination leaves standing only those with good posture.
2. Marching Test. Those who survive the standing test are given the "marching test." They are put through various marching movements for from four to five minutes. As the march proceeds and muscle [illegible] poor body mechanics cases who have posed long enough to pass the simple standing test.
3. The Exercise Test. This is then given to those who have passed [illegible] faulty muscle balance and poor body mechanics habits. Those who

Bancroft, J. H., *The Posture of School Children*, p. [illegible], Macmillan Co., [illegible]

pass this test are placed in Division One. This triple test is generally given once each month, and the ratings are posted.

This triple test is used to determine the actual body mechanics of the student. It shows what he really can do under ordinary activity.

Crampton[1] tests and measures posture by his "*Chest-abdominal ratio.*" This test is based on the importance of the proper relationship between the size of the chest and the size of the abdomen. When a normal individual slumps, his organs slump. The effect on the vital organs of this "slumping" of the body is no longer a matter of conjecture. Crampton thus measures good and bad posture by the relation of the girth of the chest to the girth of the abdomen. His test to ascertain the chest-abdominal ratio is as follows:

The chest is measured at the end of inspiration and again at the end of expiration. These measurements are taken just below the inferior angle of the scapula in back and above the nipples in front. Then the abdomen is measured at the end of inspiration and at the end of expiration. These measurements are taken at the fourth lumbar spine in back and midway between the umbilicus and the pubes in front. Take a case where the chest measures 44 and 40 inches, and the abdomen, 39 and 35 inches. The chest measurements in the normal individual should exceed both the abdomen measurements by ten per cent. Thus in the above case the average chest measurement is an excess of 13 plus per cent. over the average abdomen measurement and is satisfactory.

Crampton's "Total Ptosis" or decrease in height calls attention to the possibility of determining good body mechanics by a comparison between the full height of good posture and the decreased height of poor posture. These measurements are further compared with his full length in the lying position.

Crampton's "Back Wall Test" and his "*Front Wall Test*" combine the very satisfactory features of testing posture and posture training in one procedure. His "Back Wall Test" is as follows:

The student stands with his heels, hips, and shoulders against the wall. He then slides his hand in the space between the wall and his lumbar spine. The fit is usually quite loose. In an attempt to make the fit more snug he tries to press the lower back against his hand. In doing this he automatically corrects his posture, *i.e.*, he draws in the abdomen, lifts the chest, and assumes a better body position. His next task is to walk away from the wall and maintain his corrected posture.

Crampton's "Front Wall Test" is similar to the "Back Wall Test." The student faces the wall and touches his toes to it. In good posture the chest

[1] Crampton, W. C., "Work-a-Day Test of Good Posture," *Amn. Phy. Educ. Rev.*, 30:505-10, November, 1925.

touches the wall, but the nose is an inch away from it. To prevent a drawing back of the hips, the hands are placed in front of the thighs and a distance the width of the hand only must be maintained between the thighs and the wall. To assume this correct position demands the alignment of the body in a correct position. This sensing of the correct position and the means whereby it is secured is valuable in teaching the student what correct body mechanics really means.

The Schematograph is an apparatus by which the form of the student is recorded on a piece of tracing paper. Since its invention by Dr. C. Mosher and Professor Lesley, it has been used for a number of years for the purpose of securing a quick and fairly accurate record of the student's standing position. It is less expensive than photography and serves the purpose of supplying a picture of the individual's pose. A duplicate copy given to the student is useful in arousing his interest and desire to improve his standing position. This apparatus can be made by inserting into an ordinary Eastman Kodak or Graflex a reflecting mirror at a 45 degree angle. This rights the image so that it appears right side up. Ordinary tracing paper is generally used for records of the poses; and a 7 foot by 10 foot silver gray curtain and three 150 Watt lights (nitrogen) with reflectors complete the list of necessary equipment. The science department can usually assist the corrective worker in devising a schematograph.

The Silhouetteograph, invented by Mr. Norman Fradd of Harvard University, is an improvement on the schematograph. Harvard used the latter for recording body mechanics until 1923 when the silhouetteograph replaced it. Its results have been very satisfactory. It takes less time and it is more accurate than the schematograph, and the cost is less than one cent per picture. In 1926 one thousand freshmen were X-rayed (this process is an added feature of Harvard's examination) and silhouetteographed by Mr. Fradd in five days of seven hours each.

The Harvard examiners ordinarily take a second picture in May. They make no statement that this second picture is an accurate record of "how the individual habitually stands" after having taken corrective work and attended hygiene lectures; but they mention the second picture as showing "whether the student 'can,' when he wants to, maintain good standing position."

Harvard reports a new system of grading postures which has not yet been entirely perfected. This system was devised by Dr. Joel Goldthwait. While it is questionable whether a one hundred per cent. mathematical rating for body mechanics is in sight, this newer method allows for more accurate mathematical ratings than the older one. The former method was largely a matter of judging the student's picture by comparison with the "A," "B," "C" and "D" standards. The newer method is, in brief, as follows:

The silhouetteograph is taken. Dots are placed on the picture at the following places:

a. Mid-cervical region, at level of jaw angle.
b. Mid-dorsal region.
c. Mid-lumbar region.
d. Pelvic region, at middle of inclination of pelvis.

A line is drawn through the first two dots (dots "a" and "b") extending down to the feet and above the head. A line is then drawn through dots "c" and "d" in like manner. A postural rating is then made by measuring the angle formed by the intersection of the two lines. The suggested rating scale is as follows:

"A" 1 to 10 degrees.
"B" 11 to 20 degrees.
"C" 21 to 30 degrees.
"D" 31 to 40 or more degrees.

This angulation does not cover some common difficulties. First, in some figures the lines do not intersect on the figure. These cases must be rated "D." Second, when the intersection occurs below the pelvic point, there is

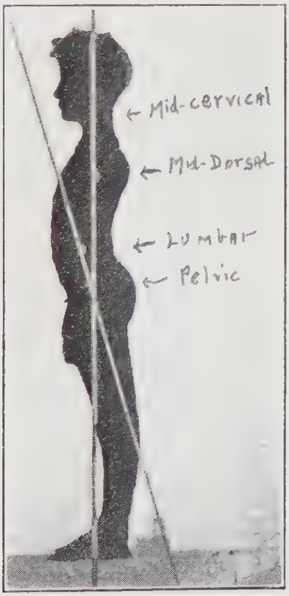


FIGURE 22

Showing poor body mechanics

FIGURE 22-A

Showing same student with improved posture and lessened angle

some confusion on the rating. These also must be rated as "D." The location of the pelvic inclination is also beset with difficulties. Proper marking of the figure may assist the examiner in determining the pelvic angle. It is seen at a glance that the nearer the four points simulate one line, the more perfect is the balance or body mechanics. Physical educators will watch the work at Harvard with interest to see how this system finally works out.

The use of the schematograph or the silhouetteograph is necessary where the Harvard system of rating, or copies of this system, is used. Miss Drew [1] records a method of grading posture which uses the "A," "B," "C" and "D" rating. Her method rates points for various parts of the body as follows:

Head	3 points
Chest	3 points
Dorsal curve	3 points
Lumbar curve	3 points
Abdomen	3 points
Weight distribution	5 points

Total 20 points.

"A" equals 20 points which is credited as 100 per cent. Her complete table is as follows:

Grades	A	A−	B+	B	B−	C+	C	C−	D+	D	D−
Points ...	20	19	18	17	16	15	14	13	12	11	10
Percentage	100	95	90	85	80	75	70	65	60	55	50

The University of Oregon reports a group rating system which is a trifle more inclusive than Miss Drew's. The Oregon system is as follows:

Total standing score, 0 to 15, determined by the following:

Toes straight ahead	1
Ankles straight	1
Weight properly distributed	1
Abdomen drawn in and lower back not unduly curved	5
Chest lifted	2
Shoulder blades flat	1
Shoulders not hunched	1
Head held erect	3

Total marching score 0 to 15.
This is recorded as 0, 5, 10 or 15.
Possible final score 0 to 30.

Photography and X-ray are of course the last words in body mechanics examinations. Photography is used in smaller systems where the expense

[1] Drew, L., *Individual Gymnastics*, pp. 98-9, Lea and Febiger Co. (Third Edition).

does not have to be seriously considered. It gives a clear-cut picture of the individual. On the other hand, it has the bad feature of positively identifying the one whose picture has been taken and this fault must be considered in many of the worst cases. In the schematograph and the silhouetteograph the pictures are numbered, and the facial characteristics are not accurately identified.

Dr. C. L. Lowman's method gives a group examination system which results in a rough classification of obvious defects of body mechanics such as weak ankles, flat feet, knock knees, round shoulders, round or hollow backs, unlevel hips and shoulders, etc. His method is as follows:

"At the beginning of the quarter or semester, the new pupils are lined up, and the examiner, accompanied by a secretary, passes down the lines and notes, first, all cases of unlevel shoulders, again, passing a hand down the curve of the waist and hips and then placing the thumbs on the anterior superior spine of the ilia, he notes unlevel hips or tilted pelvis.

"The secretary notes the pupil's name, each time under each defect. Lining them up again, the examiner approaches from the end of the line, passes the hand over the back, and notes prominence of scapulæ, round, flat or hollow back, and head position.

"Position of the squad is again assumed, and by pressing slightly backward on the knee as well as by inspecting directly, the examiner detects back knees. Next, the pupils stand with feet parallel, knees touching. Those whose malleoli touch and whose condyles do not, obviously, have varying degrees of bowlegs, and the reverse condition implies knock knees.

"In the feet parallel position, if the patella points toward the median line of the body and not foward in the median line of the leg, there exists inward rotation of the leg and compensatorily pronated ankles or relaxed arches.

"Bring the class to attention again without mentioning their feet, and note foot positions. It is easy to observe faults in foot alignment in gymnasium slippers, and notation is made as to pronation and relaxed feet.

"When this data is assembled, it will be found that certain ones will be registered for two or three defects, or, in a word, are generally relaxed. This worst group should have immediate attention. The parents should be petitioned for permission to make a detailed examination with clothing removed, and cases that need expert attention can be referred to the proper clinics or orthopædic surgeon for necessary care." [1]

The noteworthy feature of Dr. Lowman's method is that there need be little delay in putting the examination across; fifty or sixty pupils can be thus generally examined in an hour. Usually where one school physician

[1] Lowman, C. L., "Preventive and Prophylactic Orthopædic Practice," *Amn. Jour. of Orthopœdic Surgery,* 3:576-83, November, 1921.

must make the examination, a number of schools are often left until late in November before their turn for examination arrives. Thus a system which allows for earlier examination should be seriously considered.

Determining What Test to Use

The various systems discussed above are typical of the most important used throughout the country, and much can be said for them. The final choice of a system must necessarily depend upon whether or not it fits existing conditions in the particular community for which it is proposed. The following points should be kept in mind in choosing a system of examinations for body mechanics.

a. *Simplicity.* Awe-inspiring and elaborate devices may be helpful under certain conditions, but they often demand too much of the examiner's time without producing information which is actually necessary in work with body mechanics. Many of these more elaborate systems are impractical in the type of schools where body mechanics work is contemplated. The bulk of the work in correcting faulty body mechanics must be done in the elementary schools, and elaborate and expensive apparatus is out of the question in the average elementary school. A simple test to meet the gross needs of this elementary group (Dr. Lowman's method or the Bancroft Triple Test) and yet not cost too much money must be chosen.

b. *The Information the Examiner Receives from the Examination.* The examination should give to the examiner worthwhile and accurate information regarding the posture of the student. In many of the tests mentioned, the individual *poses* while the elaborate apparatus records his pose. This pose is not, as a rule, the student's habitual attitude. The examination must do more than "take a picture." It must determine how the individual habitually uses his body in his daily activities.

In cases where the individual's muscle tone is deficient and he presents the characteristic signs of fatigue posture such as head thrust forward, chest flat, abdomen protruding, spinal curves increased, feet abducted, etc., elaborate apparatus is not necessary to determine whether the individual is or is not using his body correctly. It is evident that he is *not* using his body correctly no matter how well he temporarily poses for his picture. The examiner may measure the subcostal angle, take pictures of temporary poses, determine the "chest-abdominal ratio," etc., but has he improved on his first inspection of the individual? In the majority of cases he has not.

c. *The Value of the Examination to the Student.* The instruction which should be given to the student at the time of the examination is often neglected. When a "D" picture is taken, the individual should be informed as to why he is rated "D." Wall charts showing his faults and the disadvantages of poor body mechanics are useful in putting this message across

to the student. He should be shown, and given an opportunity to practice, the correct body mechanics position. The value to the student of the correct position should be strongly emphasized. Corrective exercises which will develop strength and muscle sense in the correct position, and form new habits of body mechanics must follow the examination if the examination is to be productive of real results. The system can be rated as successful only when right habits of body mechanics are practiced outside of the gymnasium as well as in the gymnasium.

d. *Requirements on the Physical Educator's Time.* A word of caution should be given on the inadvisability of burdening physical educators with an elaborate system of examinination which makes them good statisticians but robs them of valuable time which should be spent in correcting obvious faulty body mechanics. Some of the above systems take a great deal of time and money which might be used to better advantage in actually preventing and correcting faulty body mechanics. The schematograph takes a great deal of time when used with a large number of individuals. The silhouetteograph takes much less time than the schematograph. In a large group then, the silhouetteograph is the obvious choice as far as time is concerned.

e. *Workability.* In many school systems the examination procedure is planned by an enthusiastic organizer who, if he did the examining for body mechanics, would arouse the student's interest and make the examination worth while. Unfortunately he does not do the examining. The one who takes the poses of the students fails to use his opportunity for instruction of the students and often performs his examination in such a perfunctory manner that the student naturally considers the entire procedure as "another waste of time."

Thus the choice of the examination procedure depends on a number of important factors. More than one system should be investigated before one is definitely chosen. It will be noticed that a careful inspection of the individual by a keen examiner is far more valuable than the perfunctory examination composed of numerous measurements of the various parts of the body and a picture taken by a disinterested examiner. The trained examiner can quickly detect the abnormal body mechanics while questions of a general health nature are being asked. In this way the student is not aware of the fact that he is being rated on body mechanics. After an habitual body mechanics rating has been made, the examiner may ask the student to take what he (the student) feels to be his best position. Suitable instruction as to how the student may maintain correct body mechanics may be given at this time.

Thus for best results the examination should be a period of instruction and practice in good body mechanics. Crampton's tests (Back Wall and Front Wall Tests) train the pupil in correct body mechanics at the same

time he is examined for body mechanics. The examination must consider the habitual body mechanics attitude of the student and not confine the final evaluation of body mechanics to a "pose." The Michigan system and the Bancroft Triple Test are examples of this point.

No disparagement of the use of the various examination procedures listed above is intended. But care must be taken that the interpretation of the records secured by the above procedures be made more accurate. The "A" and "D" cases are quite obvious; the "B" and "C" cases are accurately recorded by the schematograph and the silhouetteograph; a great deal of preventive work can be done by bringing to light the large number of "B" and "C" cases and preventing them from becoming "D" cases. However, it must be understood that the pictures alone are not the final factors in the classification of body mechanics. Just as the "Height-Weight-Age" tables for malnutrition must be interpreted in the light of other physical and mental findings, so the pictures of body mechanics must be interpreted in view of the medical examination findings, the musculature of the body, the habitual position of the feet, the way in which a person uses his body when he is not posing for a picture, etc. The examiner must interpret his pictures and the results of his examination in view of habitual body mechanics and not entirely of temporary poses.

In systems where an examination card is used to record the findings of the body mechanics test or where more details are needed succeeding a rough classification, the following points should be carefully recorded:

1. Doctor's diagnosis and his recommendations.

2. The general tone and nutrition of the body. This will include height and weight if these have not been recorded in the regular examination. The tone and nutrition of the body, with the estimation of the mechanical efficiency of the body (point 15), are best recorded when the individual is not aware that he is being examined, as, for example, when matters of general health are being discussed, or when the student is walking toward the examiner, or when he is standing in the relaxed position.

3. Position of the head. Note whether the head is thrust forward or is drawn too far back. This latter position is often noticed in students who, feeling that they must look their best, attempt to pose in what they feel to be a correct body mechanics position.

4. Position of the shoulders. This must include the scapulæ.

5. Exaggerated dorsal convexity.

6. Depth and width of the chest in relation to the build of the individual.

7. Abdominal area. Note tone of the muscles, abdominal scars, etc. Numbers 6 and 7 may be used for the "Chest-abdominal ratio."

8. Hollow back. A depth of more than one inch from a vertical, which

touches the prominent parts of the spine, is considered abnormal. A narrow rod is used for this measurement.

9. Lateral curvatures of the spine. The direction and the number of vertebræ must be recorded, *e.g.*, right dorsal convexity—second dorsal to first lumbar. Asymmetries of the ribs in front and the position of the scapulæ in back will assist in identifying scoliosis.

10. Legs and knees. The knees should be straight but not stiff. Note any knock knee, back knee, bow legs, inward rotation or tibial torsion.

11. Flexibility of spine and joints.

12. Feet. Note strained, weak, restriction to flexion, extension, eversion or inversion, muscle tone, tenderness, calluses, or corns, deformities such as hallux valgus or hammer toes, flat or sunken arches, mode of standing, *i.e.*, feet turned out or parallel or turned in, etc.

13. Weight distribution. The government charts, the Harvard chart, or the window pole test will determine this point.

14. Complaints of pain or fatigue in the legs, feet, or back.

15. Estimation of mechanical efficiency of the body. Use Drew or Oregon material. This may be rated by answering the following:

a. Is the body in good anatomical position?
b. Does the position favor freedom of movement?
c. Do the observable signs point to organic vigor?

Beyond the points mentioned above, the card should contain a code such as, 1. for normal, 2. for slight defect, 3. for moderate defect, and 4. for severe defect. For example, dorsal convexity very much exaggerated would be recorded under point 5 as follows: "4." For proper follow-up work in each case it is recommended that the following spaces be allowed:

1. Summary condition of the student.
2. Treatment recommended, and the date recommended.
3. Treatment given, and the date or dates given.
4. Results obtained, and the dates.

A sample card which may be used for special body mechanics rating following a regular examination by a physician is as follows:

See Figure 23, "Body Mechanics Examination."

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FRONT OF CARD
4 x 6 inches

School
Name Dept. of Corrective Phy. Educ.
School year Class hour Number

Medical and Personal History Summary *

General tone, Nutrition
Head
Shoulders
Dorsal convexity
Chest in relation to build
Abdomen
Lower back
Lateral curvature
Legs and Knees
Flexibility of spine and joints
Feet
Weight distribution
Student complains of pains, where? degree?
Estimation of mechanical efficiency of body

Sig. of examiner ....

* This should be the summary made by the examining physician.

BACK OF CARD
4 x 6 inches

Follow-up

Summary of condition of student
(e.g., Poor tone, head 3, shoulders 3, dorsal convexity 3, etc.)

Treatment recommended date

Treatment given dates

Results obtained date

FIGURE 23

Body Mechanics Examination

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CHAPTER V

THE TREATMENT OF FAULTY BODY MECHANICS

The treatment of faulty body mechanics has been too largely concerned with the attempt to relieve the local condition. Successful relief or improvement of faulty body mechanics must embrace a much larger scope than the local condition. It must consider the entire body and the various environmental factors which influence body mechanics. The habits of the individual, his environment, his occupation, his use of leisure time, his mental set and his general health and body tone influence body mechanics. These factors must be considered in the treatment of faulty body mechanics.

I. FACTORS TO BE CONSIDERED IN TREATMENT OF FAULTY BODY MECHANICS

For clarity the treatment may be divided into five divisions:

A. Educational principles.
B. Removal of cause.
C. Proper health habits.
D. Restoration of strength.
E. Exercise.

It must not be construed that these divisions are entirely independent of one another. There is no sharp line of demarcation between any of them; for example, the removal of the cause in many cases will involve the changing of the faulty health habits to proper health habits.

A. Educational Principles

To attempt to treat faulty body mechanics without first teaching the individual why he should correct this condition, can lead only to failure. The educational procedure generally carried out in corrective work is as follows:

1. Show the individual the value to him of correct body mechanics.
2. Thoroughly teach the individual what good body mechanics is.
3. Make good body mechanics traditional.
4. Arouse interest by posture drives.

A-1. *The value of good body mechanics must be thoroughly understood and finally accepted by the student.* In many cases he is entirely indifferent to the instructor's efforts to correct body mechanics. He thinks that the instructor is working for the æsthetic value only, and therefore since the habitual slump seems perfectly "all right" to himself, why should he forsake it for a new and unfamiliar posture, which, though it might be correct, is not so comfortable as the slump? This indifferent individual must be taught the value to him of correct body mechanics—a value which is expressed in terms of increased vigor, lessened fatigue, and diminution of wasted energy.

In many students the instructor finds various hopes and desires which he can use to stimulate interest in bettering physical condition. One student has a girl! Of course he wants to look his best. He looks best when he holds himself in a good position. Another is athletically inclined. Better functioning of the body and greater skill of body movements are more likely to be secured with the body properly aligned. Even the bookworm can be shown that a body which is functioning at its best will allow the greatest mental efficiency.

The student must be aroused to a desire to improve his body mechanics. The simple statement of the effects of good body mechanics does not always insure favorable action on the part of the student. The very best salesmanship tactics must be constantly used to awaken within the student that sincere wish for correct body mechanics. He must eventually and habitually assume the correct body mechanics position without any urging by the instructor. Until this stage is reached, constant work must be done to convince him of the value to him of correct body mechanics. Positive suggestion will be found more helpful than negative suggestion. Also, it is futile to argue with him that he should or must stand correctly. This method only ruins the instructor's disposition and further antagonizes the student. The student must make his own decision for correct body mechanics, and he makes this decision only when he has realized the value to him of correct body mechanics.

The conscious desire for good body mechanics may be aroused in the elementary school child by calling attention to popular heroes with good body mechanics and stressing the deeds which they have accomplished. The child, being a natural imitator, has a good example to imitate. It is almost unnecessary to remark that too great emphasis on the body mechanics of these men is not as good as a slight reference to their erect carriage. Pictures of some of the famous athletes who have very good postures will invariably appeal strongly to the high school boy.

2. *The student must be thoroughly taught what good body mechanics is;* it is too much to expect that he already knows. Continued experience in

this work will convince any instructor that the average student must be carefully taught how to hold his body correctly. The triple mirror is useful in teaching this lesson. The student is placed, by manual assistance of the teacher, in the correct position. He *sees* the correct position and he *feels* the correct position. He is then allowed to slump and is again corrected until he thoroughly understands the following points:

a. How poor body mechanics looks and feels.
b. How this position can be corrected.
c. How the corrected position looks and feels.

The silhouetteograph can be used to show the student how he really looks. It is his picture and he may keep it. Another picture of the corrected position may then be taken and comparisons made. It should be stressed at this point that this second position is not always habitually maintained. The instructor should be on his guard to call to the student's attention any lapses from the corrected position. After another month or more of corrective work a third picture may be taken to show the individual the improvement which he has made in the way he CAN stand. Here again he must be cautioned that the thing which counts is the habitual position and not the pose. He should be shown that he is only cheating himself if, when he CAN stand correctly, he does not habitually maintain this posture.

Hygiene lectures may be made more interesting to the college student if two lectures are given early in the semester as follows:

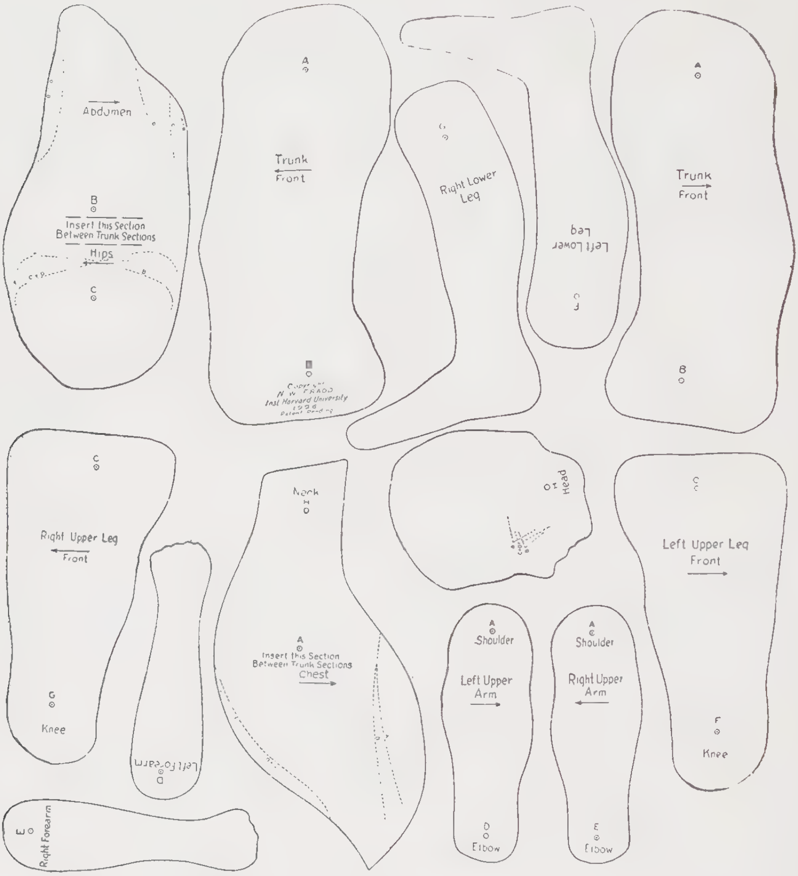
First lecture. Dealing with the relation of correct body mechanics to health and efficiency.

Second lecture. Dealing with the common causes of, and the possible prevention of, foot troubles.

The Posture Manikin (cut-out) is helpful in teaching what good posture is. See Figure 24.

3. *Good body mechanics must become TRADITIONAL.* The statement is often made that good body mechanics is instinctive. No doubt the savage had a better balanced body than civilized man of to-day, but the savage lived a more vigorous, outdoor life and was not subjected to the environmental influences which have seriously affected the body mechanics of the modern man. The healthy child of two years of age presents a very erect carriage though often a slightly rotund abdomen. (This abdominal protrusion should abate when the pelvic cavity becomes larger.) But the business of "growing-up" is beset with so many posture-disturbing factors that it becomes necessary to make a conscious effort to maintain correct body mechanics.

Too many people are willing to slump along in their daily activities.



DIRECTIONS FOR ASSEMBLING CUT-OUT

1. Cut out sections. Do not cut on dotted lines.
2. Punch or prick with pin all lettered points. (Ex.- A.)
3. Match up sections which should go together at points or joints with similar letters (Ex.:— All "A" points are placed together, all "C" points are connected, all points marked "H," etc.)
4. Assemble figure using brass pins (8 pins necessary). All printing will be covered when manikin is together.
5. The dotted lines indicate various postures.
(Ex. If the dotted lines on Head, Chest, Abdomen, Back and Hip sections are set at "D" the manikin is in a "D" or very poor posture. "A," "B," and "C" postures are arrived at by following the above rule.)

Prepared and issued by Norman W. Fradd, Instructor in Physical Education
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FIGURE 24

Posture Manikin
(Cut-out)

They give little or no attention to the matter of correct body mechanics. The various activities of life encourage an overactivity of the flexor muscles of the body and a subsequent stretching of the extensor muscles. The lack of physical activity in these people allows for a gradual softening of the supporting muscles of their bodies, and poor body mechanics result.

After the desire for correct body mechanics has been aroused within the individual, this must be carried to the point that it becomes the traditional carriage. In the average examination of to-day it is unusual to see a great many individuals with correct body mechanics. Yet such a situation is possible. The Polytechnical Institute of Baltimore, Maryland, is known for the correct carriage of its students. In the issue of December 5, 1923, of the "Poly Press" a very good article on body mechanics started with the following statement, "Know a Poly Boy by His Walk." It continued to state, "We want every boy to stand and walk correctly, so that any one can recognize him as a student of this school." The value of correct body mechanics to the student was carefully stressed, and nine points were listed to enable the student to determine what good body mechanics is. The article concluded with the statement that there is a golden mean in posture, which stands for self-respect and self-confidence, combined with courtesy and consideration for others.

The cadets at West Point, the middies at Annapolis, and the graduates of these two institutions are known by their erect carriage. It is traditional that these fine specimens of manhood should hold themselves in a position which makes them outstanding in any group.

To make good body mechanics traditional the student must realize the value to him of this correct position of the various parts of the body. A variety of appeals may be used, differing according to the ages and tastes of the students. The boy who has achieved the most improvement in his body mechanics may be rewarded by seeing his name on an honor roll or by receiving a monitorship for a certain length of time. Or the group instinct of defeating the other class, the social instinct for looking well, or the patriotic desire to appear soldierly—all of these are useful in making correct body mechanics so interesting that it will become traditional and replace permanently the "slump" habit, too common to-day.

4. *Arouse interest by Posture Drives.* Drives are helpful in charging an idea with emotion which forces itself into the otherwise indifferent mind, and posture drives are no exception to the rule. A great deal of publicity is needed preceding the drive. But where the field is properly prepared, much good will result.

A number of very clever drives have been used by various schools throughout the country. Miss Florence D. Alden of the University of Oregon reported a very complete and rather unique drive which met with huge

success.[1] Some of the appeals used were reported in "Old Oregon" (March, 1924) as follows:

"'Do you stand as straight as this tree?' were the words on a huge placard on a particularly well-shaped example near the walk between the Commerce building and the library. 'Have you scoliosis like this tree?' called wide attention to the natural afflictions of the small specimen near the senior fountain—afflictions generally overlooked by the student body. One staunch fir along Deady Walk bore the message, 'Copy nature—stand up straight.'

"Big footprints of green paint on the principal campus walks showed the advantages of correct tread. *The Emerald* fell in line and that day's issue had between the stories not the usual line dashes, but cut-offs which said in italics, 'R.U.A. Leaner?' 'See your Shadow.' 'Are you wearing correct shoes?' and 'Is your posture worth looking at?'

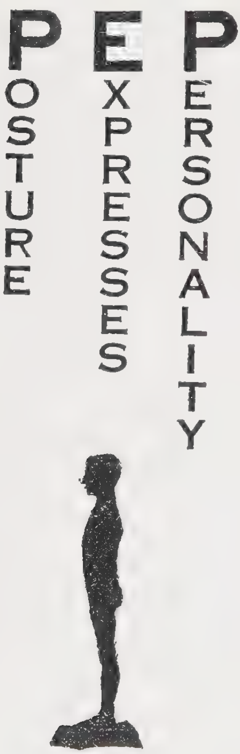

FIGURE 25

"During the week preceding the drive, a rather large poster made by the girls in charge, displaying the evils of poor carriage and the æsthetic, moral, and mental value of an upright position, was given to each women's organization on the campus to be displayed in the house. They were attractive and clever, each with a catchy slogan such as 'Fifty Years Ago a Woman Was Known by Her Carriage.' 'Do You Look Like the Hump Family?' and 'The Débutante Slump Brings the Middle-aged Hump.'"

Various skits and stunt shows, lectures by department heads, etc., were used to further the interest in correct carriage. The drive culminated in the posture tests (see Oregon test) given in all the gymnasium classes and in all the women's houses. Out of 720 girls tested 284 of them scored 23 out of a possible 30 points (23 or better was rated as passing) and were entitled to wear the little tags, "Posture Expresses Personality." See Figure 25.

Besides the above schemes for use in posture drives there may be posters made by the students, posture policemen and policewomen who tag the good and bad postures, and lectures by doctors and others who have good body mechanics. Posture parades, debates, and public honoring of the one who has made the greatest improvement in his body mechanics, are also very helpful.

[1] Alden, F. D., "Putting Punch into Posture," *Amn. Phy. Educ. Rev.*, 29:179-82, April, 1924.

Miss Drew[1] describes a similar drive which was very successful at Vassar College. This drive included posture tests, exhibition of posture posters, parade of students who demonstrated "slump postures," college paper publicity, short speeches on posture and shoes, posture tag day, S.U.S. (Sit Up Straight) cards, etc.

The bizarre nature of these good posture weeks or body mechanics drives attracts attention and arouses interest in the majority of students. But the most important work must come afterward. Unfortunately this follow-up work is negligible in the majority of drives. Too much stress cannot be laid on the necessity for its thoroughness. Where there is good follow-up work, the aroused temporary desire for correct body mechanics can be made permanent and productive of some very effective work in correcting faulty body mechanics. The one week should be preparation for the intensive work which is to follow.

B. Removal of Cause

After the various educational procedures have been thoroughly carried out, the actual cause or causes of the faulty body mechanics should be dealt with. The mistake is often made at this point of attempting to correct the local condition without first removing the cause of it. The necessity of a careful medical and physical examination is quite evident at this point. The past history of the individual, his habits, etc., should reveal one or more causes of the faulty body mechanics, which will usually fall under one or both of the following heads:

1. *False load, i.e.,* environmental influences such as improper seating in school, improper clothing, injuries, defects such as impaired vision or hearing, heavy chores or occupations which distort the body, etc.
2. *Internal manifestation of ill-health, i.e.,* general debility, results of toxic infections such as diseased tonsils and unsound bone tissue. Lack of physical activity will also show in a poor tone throughout the body.

B-1. The false load must be removed as quickly as possible. The various types of false load cause fatigue and lower the resistance of the organism. The individual who is handicapped with faulty vision or impaired hearing should be provided with glasses or given a seat in the front of the room or close to the blackboard. The undernourished child should be treated from the nutritional side as well as given exercises to correct his faulty body mechanics. Correct postural habits must be substituted for the customary habit of faulty body mechanics. Injuries and deformities must be treated by the orthopædic surgeon in order that the function of the defective part

[1] Drew, L., *Individual Gymnastics,* pp. 93-5, Lea and Febiger Co., Third Edition.

may be as near normal as possible. For example, in cases of infantile paralysis suitable bracing of the limb in the correct position will eliminate the continued aggravation of the deformity which often results where the limb is not braced and the individual is allowed to develop an incorrect and fatiguing gait and will favor the development of the body in the correct manner. Contracted psoas muscles and shortened iliofemoral ligaments must be lengthened.

Braces are often recommended as an initial step in the correction of local deformities such as round shoulders. But a case of round shoulders is not the same as a case of infantile paralysis and though in a few cases of marked shoulder deformity they may be used for a short time, yet in the majority of cases of round shoulders, braces are not recommended. For the shoulder braces pull the shoulders back and allow the back muscles to be relatively inactive. Also in many cases the flexor muscles of the chest and front of the shoulders pull against the braces, thus growing stronger and shorter. A definite resistive exercise is offered to the anterior chest muscles which further develops these already overdeveloped muscles. The average individual who is wearing shoulder braces is all too willing to allow the brace to do the work which should be done by the posterior back muscles. Where suitable exercises are used in connection with the proper brace, the individual may be taught to assist the brace in maintaining correct carriage. In this way the symmetry is gradually restored, and the muscles on the front and back of the shoulders are strengthened enough to maintain a correct position. There is very little objection to the use of exercises and braces, *providing* the individual is coöperative and does his part well. But in the majority of cases the spirit may be willing but the flesh is weak, and the individual slumps against the brace and allows the muscles to become further unbalanced in their proportionate strength. Too many of the braces which are recommended for shoulder conditions have the bad effect of producing a lordosis and an actual thrust forward of the head (bantam posture). The question of braces for shoulder conditions should be left to the orthopædic surgeon who generally prescribes exercises as a supplementary measure to the use of them.

The habit of carrying books under one arm throws the body out of balance and must be considered as a false load. The sedentary worker who habitually uses his flexor muscles more than his extensor muscles is laboring under a false load. Counteraction must be given in the way of more vigorous action by shortening the overstretched extensors on the back of the body. Desks which are too low for the student must be adjusted to allow him to maintain with comfort the correct position. Seats also may need adjustment to relieve the false load which comes from improper seating.

2. The internal manifestations of ill-health must be carefully considered

and these conditions removed. The cases which are suffering from some infection must first be treated medically to relieve the infection. Thus a student with diseased tonsils, decayed teeth, etc., must have the toxic condition relieved before any good results can be expected from his work in corrective physical education. The necessity of rest for those individuals who have just recovered from a debilitating illness or who have overworked must be stressed. To the individual who is physically inactive more vigorous exercise must be given to restore muscle tone, muscle sense, better reciprocal innervation by coördinated activities which will improve the reflex activity and restore better neuro-muscular coördination, and also that sense of static and moving equilibrium which has a great deal to do with correct body mechanics.

In the majority of cases there will be found definite cause or causes for the condition of faulty body mechanics. Tuberculosis of the spine, which leaves the spine distorted, cannot, of course, be considered as a removable cause, and neither can infantile paralysis. But compensation by proper bracing can help in these cases. In other words, the deformity must not be allowed to increase. In the average case, however, a careful medical examination will usually reveal some existing cause or causes which can and must be removed before satisfactory results can be secured.

Special stress should be laid on the necessity of giving the internal organs a fair chance to function properly and thus provide the maximum of organic vigor to the body. Without this organic vigor it is almost impossible to hold, for any length of time, a position of correct body mechanics. Thus in cases of undernourishment it must be the first principle in the treatment of faulty body mechanics to remove the condition of weakness which accompanies the undernourished condition and to raise the level of strength of the individual to a point where he has the organic and skeletal power to hold the corrected position once it has been accomplished.

C. Proper Health Habits

The hygienic habits of the individual must bear careful scrutiny, and where habits are not productive of good health, they must be changed. This process, of course, overlaps the "removal of the cause." The average faulty body mechanics case gives a history of failure to obey the common everyday laws of good hygiene. His diet is faulty; he fails to take sufficient and correct exercise; he does not get sufficient sleep. In many cases the student wastes his energy in evening parties. He is very tired the next day. He often sits up until late at night, curled in an overstuffed chair and reading before a poor light. These causes of ill-health and faulty body mechanics must be attacked before any good can be expected from the exercise program. Organic and skeletal vigor must be worked for, and a sufficient amount of

resistance stored up so that the individual will have enough energy to maintain the correct carriage once he appreciates the value of this carriage and actually understands how to hold his body correctly.

Good posture depends upon the maintenance of natural conditions of life. The more artificial the environment, the greater the tendency toward destruction of the habit of good posture. Emphasis must be placed on the changed conditions of modern life and the necessity for more care of our bodies in this artificial environment.

A feature which is often overlooked in cases of faulty body mechanics is the mental side. Many of these poor body mechanics cases are just a few steps behind in all their work. They are not quite making their grades in school. They worry because of this inability to keep up with the rest of the group. This worry fatigues them and they find themselves in a vicious cycle. Encouragement, rest, and light recreation often changes the state of mind of the student and paves the way for success in the treating of his faulty body mechanics. This particular type of student is the one who responds very poorly to nagging. He need not be told that his posture is poor. He needs an understanding of his condition and positive suggestion. He can be told just why he is falling behind. He can be shown how correct balance of the body will relieve strain and thus spare energy which can be applied to work on his studies. Many students who have fallen into this vicious cycle have been very much helped by encouragement on the part of the instructor and a light program of exercises which increased the physical efficiency and in turn increased the mental efficiency of the body. Numerous cases could be cited of college students who were failing on a light academic program and yet, after taking corrective work, carried a heavier program without difficulty.

D. Restoration of Strength (Organic and Skeletal)

This phase of the treatment of faulty body mechanics has been repeatedly referred to in the "removal of the cause" and the "improvement of health habits." One of the outstanding symptoms of faulty body mechanics is muscular weakness. This is especially true in the period of rapid growth. The muscular system fails to keep pace with the rapid bony growth and awkward postures often result. The muscular system must be sufficiently developed to maintain the correct body mechanics position. Weak abdominal and lower back muscles or faulty coördinations of these muscles tend to distort the posture.

Advice against the use of braces in correcting faulty body mechanics arises from the fact that in too many cases the correction is accomplished by the brace while the strength to maintain the correct position is lacking. After a correction has been made and the individual understands the me-

chanics of the corrected position, there must be the organic and skeletal strength to maintain the corrected posture.

E. Corrective and Remedial Exercises for Faulty Body Mechanics

Suitable emphasis has been given to the importance of the educational training, proper health habits, etc., to make the reader aware of the fact that a great deal of work must be done before exercises may be started. Simply trying to strengthen weak muscles will not be productive of satisfactory results unless the individual understands what is good posture and has the desire to change his poor body mechanics habits to correct body mechanics habits. This must not be interpreted to mean that good muscle tone is not necessary. Good muscle tone is necessary but is largely dependent upon correct body mechanics. Training must be given in correct muscle tone habits. The muscles which are not functioning properly must be so trained that correct habits of control of the body positions can be formed.

Corrective exercises for faulty body mechanics are beneficial if the other principles of treatment are fully carried out. In the end, corrective exercises are the means whereby the student really puts into practice the various theories which he has been taught regarding body mechanics. He has been told what good body mechanics really means. Exercises are necessary to strengthen the muscles which will be used to maintain this correct posture; they are also used to strengthen the habit of correct body mechanics; and, finally, they are used to prepare the individual for a better physical life which will maintain the correct poise.

It must be borne in mind that rational exercise is beneficial to the various systems of the body; it gives them better organic and muscular tone. The individual who is in good health and whose organic and muscular systems are functioning efficiently usually presents a higher rating in body mechanics than the individual who is in poor health. The individual who is in good health can enjoy life more fully, and the aim of the corrective department is to hasten this time for enjoyment as much as possible. A certain amount of formal and developmental work is necessary to prepare the individual for the time when he will engage in the various play activities which are within his capacity. This preparation for play activities is sometimes expressed in terms of development of bodily vigor and correct carriage. The individual is trained to manage his body to the best advantage with reference to his environment.

The average child who is free to stand, walk, run, climb, and use his large muscles in all kinds of motor activity usually presents a good posture. The majority of poor posture cases in the average college freshmen show a history of not having had the above advantages. The remaining few owe

their poor body mechanics to faulty hygiene, specialized sports and occupations, accidents and illnesses, etc.

In using the exercise phase of treatment of faulty body mechanics, the following principles should be kept in mind:

1. *Individuals Differ in Physical as Well as Mental Development.* Exercises must be prescribed to meet the *individual's* needs and capacity. The flexible type of individual needs exercises which will stabilize the correct body mechanics position. The stiff or non-flexible type needs flexibility to enable him to assume the correct position. Care should be taken, however, in promoting flexibility in the stiff type of individual that there is proper provision for maintaining a correct posture. The bad postures must be changed to good body mechanics and the bad posture habits must be changed to good posture habits. If this is not done, an exaggeration of the present condition will often result. In many cases the pull of gravity and the habitual slump are found to follow one another. When flexibility is secured and the faulty attitude is continued, the poor posture position is made worse. Thus a relaxed bar hang is good for the stiff heavy set type of individual, but an active bar hang is better for the flexible type. Thus the following points must be kept in mind:

a. Correction must be made.
b. The correction must be "fixed."
c. Habits of exercise in the corrected position must be constantly stressed.
d. There must be a firm fixation of the corrected habits.

2. *We Learn by Repetition.* After the individual knows what is good body mechanics, has the muscle or kinesthetic sense of muscular movement and position, and has the desire to correct his faulty posture, he must be given the opportunity to assume frequently the correct position. Constant repetition is needed to establish firmly in his neuromuscular mechanism the correct body mechanics habits. After these habits are firmly established, there must be continued repetition in order that the muscular system will become strong enough to maintain the correct position without undue strain or fatigue. The muscles must be habituated to the correct lengths and balance.

One way in which the correct body mechanics position can be impressed upon the student is to start all standing exercises from the *correct* standing position. Another scheme is the "slump and correction," in which the student is allowed to exaggerate his poor position and then to correct it. He then senses the process which makes for correction, and he also senses or feels the correct position. The student should be made to perform his movements deliberately in order to eliminate that meaningless repetition which is too often seen in the gymnasium class where the students are allowed to "slide through" their movements. The movements should be slow enough to allow

the thorough formation of correct body mechanics habits. Each movement should be definite. The goal must be in terms of perfection of movement and not of number of times done. The individual should be aware of the exact position of the various body parts, and he can be so only when he has a purpose behind the exercises.

3. *Bodily development is lacking* in the average case of faulty body mechanics. The majority of cases showing faulty postures give a history of failure to partake of physical activity. They were not, and are not, of the athletic type, and because they were not, they were not included in the ordinary athletic program. They have been deficient in function, and *their structure is deficient in tone, poise, muscle sense, general development, etc.* The majority of "posture cases" have long, slender bodies (classed as carnivorous in type) with light muscles which fatigue very quickly. This type needs general bodily development—a development which does not confine itself to the skeletal, but includes organic development as well. Lack of general bodily tone is one of the subjective signs of fatigue. This is also an enemy of good posture. Muscle tone is gained by the proper nourishment of the entire body. Hygienic exercises which increase the organic efficiency of the body pave the way for local correction of the existing deformity. When the body possesses sufficient strength and vitality, the actual correction of the local deformity can be started. Extensor tone must be worked for to alleviate the habitual attitude of flexion throughout the body. Rhomboids should be contracted, and the extensors of the back, neck, and shoulders should be given such an amount of exercise that they may properly perform their function of maintaining the correct position of the various parts of the spinal column.

4. *Recumbent Exercises Are More Valuable at First.* The greatest balance effort is needed in the standing position; less in sitting; and least in the lying or recumbent position. Therefore recumbent exercises are the first type which are used. Since gravity tends to pull the spine forward and the standing position requires relatively much effort in balance, it has been found by experience that the best body mechanics work can be accomplished by spending a large part of the first lesson, at least, in the recumbent or lying position. In this position gravity is assisting in the attempt to keep the abdomen in place and to approximate the hollow back to the floor, and the individual is more at rest than if he were standing.

The recumbent exercises possess a "margin of safety" (Lowman), and the person using them is less likely to fatigue than in any other position. The difference between the standing and lying positions in the heart rate and respiratory rate, as well as in the relief of all static joint and gravity strain, makes this position the most advisable one with which to start, especially among students who are at all physiologically inadequate.

A progression from this recumbent position is as follows:

a. Perfection of body mechanics in the lying position.
b. Perfection in the sitting position.
c. Perfection in the standing position.
d. Perfection in walking and daily activities.

5. *Rest is a Necessary Aid.* Many faulty body mechanics cases, although not engaging in vigorous physical activity, are constantly working under high nervous tension. This is especially true of the undernourished type which shows faulty body mechanics. Definite rest periods are essential for this group in order that the physical and mental expenditure may be curtailed sufficiently to allow the resistive forces of the body to be built up again. The undernourished child should usually be required to rest before and after eating. As "rest" to many may mean only a period of "slumping," the following definite rest positions are advised:

a. Lying on the back, a small pillow under the shoulders and extending down to about the tenth rib, the body resting on the floor (or on a hard mattress), the hands at the sides and the legs straight. This position allows complete rest with the body parts in very favorable positions.

b. Lying on the front of the body, the elbows slightly bent and the hands resting on the floor just in front of the head. A pillow is placed under the body (from the pubes to the sternum) to prevent the hollowing of the back.

c. Lying on the back as in No. 1 but with the hands under the back of the neck ("neck firm" position), with the elbows resting on the floor. This is really an exercise when a condition of round shoulders is present. The cultivation of this position is very helpful to posture, and the discomfort it occasions at first quickly passes away after a few trials. It is a good policy to give one rest exercise between active exercises, especially when the student's general bodily vigor is low or a heart condition is present.

d. Correct sitting and standing positions. The student should be taught that these correct sitting and standing positions are less fatiguing in the end than the slump positions.

6. *The Time and Amount of Exercise Depend Entirely on the Individual Case.* It is necessary to know what activity must follow the student's exercise session so that sufficient energy may be left for it. On the whole it is better to give too little than to give too much. For students who are coming to the clinic for "home work" instruction it is well to insist on three periods a week at the clinic and exercise periods at home on the alternate days. As to the time when the exercises are to be done at home, it is best to insist on one hour before the evening meal and then for a period of not more than

fifteen minutes. This time is chosen because the child will not do the exercises regularly in the morning due to late rising (although the morning is preferable), and at night he will be too tired to do them well. But after allowing a sufficient recreation period after school, there still remains the hour before dinner which can be divided into fifteen minutes for exercises and forty-five minutes for rest, with the body in good position. When the exercises are to take more than fifteen minutes, the start must necessarily be made proportionately earlier.

7. *Manual Correction Is Often Necessary.* Verbal instruction does not always insure the student's taking the correct local positions. This is especially true in cases of hollow backs. And since the lower back and abdomen are the most important parts in correct body mechanics, it is necessary that they be assisted to correct positions.

For the hollow back the student should be placed with his back on the floor. His knees are bent, his heels rest close to his buttocks, and his hands are at his sides. The instructor places his thumbs on the anterior superior spines of the ilia and his fingers on the sides and rear of the ilia. He then attempts to tilt the student's pelvis clock-wise as the student draws in his abdomen and tightens the muscles of the buttocks. This movement should approximate the lower back of the student to the floor and flatten the abdomen.

This same correction can be made with the student standing, although it should not be attempted until it has been well mastered in the lying position. The standing correction is as follows: The instructor places his right hand on the student's lower abdomen and his left hand on the buttocks. The student is then told to "tuck in" his buttocks and "draw in" his abdomen. The instructor assists the movement by pressing *up* and *in* on the abdomen and *down* and *under* on the buttocks. In order that the upper part of the trunk may be stabilized, the instructor places the right side of his head at the scapulæ region and presses the trunk slightly forward as he corrects the lower segment of the trunk with his hands. A very slight bend of the student's knees often assists the correction by releasing the tension throughout the body.

For flat chest one hand is placed below the student's waist, and the other hand is placed on the back between the shoulder blades. The hand at the lower abdomen controls the forward movement of the hips, and the hand at the back pushes the body forward into the correct position.

For round shoulders and protruding scapulæ the fingers are placed on the front and tip of the shoulders, and the thumbs are placed on the scapulæ. A pressure is made inward with the thumbs while the fingers pull the shoulders in place. In very resistive cases it may be necessary for the student to sit on a stool while the instructor further assists the movement by

placing his knee (long axis of the tibia) along the spine and exerts forward pressure with the knee as the shoulder correction is made.

A Word of Caution Must Be Given in Connection with the Use of Manual Correction. Vigorous, brute strength methods have no place in corrective work. If the student thoroughly understands what is wanted and how he must assist in the movement, there is no necessity for rough manual correction. And in many cases, rough manipulation defeats its purpose for it causes the student to tighten the muscles which should be relaxed.

8. *The Exercise Period Must not be Boresome.* The game element is essential to continued interest in corrective work. Dr. C. L. Lowman and Miss H. Cooper [1] seem to be the pioneers in this field. Some of the principal movements advocated by these writers are as follows:

a. Back stroke in swimming. This is better than the crawl stroke which has its pectoral shortening effect. (The breast stroke is also a fine exercise for postural conditions of the head and shoulders.)

b. Marble relays. Marbles are gripped with the toes.

c. Balance boards on the heads of the students during such games as "swat tag" and other circle games.

In addition to the above movements the author suggests the following:

(1) Volley ball and newcomb for lifting the chest and causing good head position.

(2) Backward overhead basketball throw for the posterior neck and back muscles.

(3) Backward overhead relays. (See Staley's *Games, Contests and Relays.* A. S. Barnes and Co., New York.)

(4) Hang tag. (See Bancroft's *Games.* Macmillan Co.)

(5) Basketball goal relay.

The use of many of the more popular games is possible in corrective work if slight changes are made to avoid strenuous competition and good body mechanics is not neglected. The game element, however, must not be sacrificed. Playground baseball may be substituted for regulation baseball, and all but a few types of individuals may indulge in this game. Sitting games may be chosen instead of the more vigorous running games. Swat tag (described as "whip tag" in many books) may be made a superb posture game if all hold boards (small board 5″ x 5″) on their heads. The holding of the board on the head naturally makes the game entirely different from the slam-bang game that is commonly called swat tag. The corrective value of consciously using the muscles of the back of the neck in a good postural position lies in the development of a muscle sense of this correct head and

[1] Lowman, C. L., *Corrective Games,* Amn. Physical Educ. Assn., Springfield, Mass.

shoulder position. The slight interference with the spontaneity of play when swat tag is played with boards held on the heads of the players is offset by the value of the correction.

9. *The Body Mechanics Cues Must be Meaningful.* The best that can be offered on matter of cues is to portray, to the student, by the cue given, a simple and easily understood command. Thus the cue "Stand tall" or the cue "Sit tall" conveys a picture to the student which will correct the habitual slump. The use of the cue "Chest high" involves, in the average student, a total shortening of the back muscles and subsequent hollow back and forward thrust of the head. Anything which will stretch the body upward ("Body push up" or "Press head against the ceiling," etc.) is more conducive to desired results than a number of ambiguous cues which are often used.

With the above principles of exercise in mind the next task is to fit these principles to the cases which will be met in preventive, corrective, and remedial work.

II. PREVENTIVE PHYSICAL EDUCATION ACTIVITIES

On the preventive side a great deal may be offered. The preventive physical exercise program should offset the hereditary and environmental factors which ordinarily make for ill-health and bodily defects. One of the outstanding characteristics of the individual needing corrective work is the lack of organic and skeletal development. Good muscle tone and vitality usually go hand in hand. To develop the body as a whole, three things are absolutely essential:

A. Rest.
B. Nutrition.
C. Activity.

When there is a good balance among the three factors mentioned above, there is more chance for bodily development. Thus the preventive physical education program should include the following:

A. Sufficient rest throughout the day and refreshing sleep at night.

B. Ample nourishment to provide for the daily expenditure of energy and to store up a reserve.

C. Activity of a nature which will not break down the body tissue more rapidly than it can be built up. Thus the activity must have hygienic value. It must also aim to strengthen the weaker muscles and stretch the shortened groups with the ultimate purpose of making the body as symmetrical as possible, while still promoting general body tone.

The following types of activity are offered as preventive exercises:

1. Correct body mechanics in the
   a. Lying position.
   b. Sitting position.
   c. Standing position.
   d. Walking position.

2. Correct breathing. (Abdomen well drawn in on exhalation and only slightly forward on inhalation.)

3. Correct chest position. (Pectoral muscles are stretched and upper back muscles are shortened.)

4. Abdominal exercises. (Leg raising and knee flexing from the supine position.)

5. Rest positions.

6. Balance exercises.

7. Foot exercises.

8. Large muscle activities. (Running, jumping, etc.)

9. Rest and breathing. (Combination of Number 2 and Number 5.)

10. Games.

Preventive Exercises in Detail:

1-a. *Correct Body Mechanics in Lying.* The student exhales drawing the abdomen in, and approximates his lower back to the floor. He then inhales, raising the chest, keeping the abdomen in and the back on the floor. Assistance in securing the correct pelvic tilt may be given by the instructor. Various arm, leg and body movements are given in the supine lying position.

b. Correct body mechanics in sitting. (On floor.) Legs are straight and the body is held as tall as possible. This alleviates the common fault of bending at the waist rather than bending at the hips.

c. Correct standing position. (See page 69.)

d. Correct walking position. (See page 170.)

2. *Correct Breathing.* The student should be taught that the inspiratory movement is controlled largely by the position of the head and trunk. When the head is erect and the ribs are elevated, the air flows into the lungs. The expiratory movement is showed as a drawing in of the abdomen. This abdominal position is stressed for the following reasons:

a. To offset the abdominal type of breathing which results in a protrusion of the abdomen on inhalation and only a slight recoil on exhalation.

b. To keep the abdomen flattened at all times.

c. To discourage the exaggerated inclination of the pelvic girdle which usually accompanies the abdominal type of breathing.

d. To develop the kinesthetic sense of muscle balance of the abdominal muscles so that they will remain contracted to a slight degree at all times (abdominal tone).

e. To teach the student that active expiration is followed by an involuntary inspiration.

f. To elevate the ribs and thorax. This is not done in the ordinary type of breathing which allows abdominal protrusion.

3. *Correct Chest Position.* Hold wand in wide hand grasp, with arms extended above the head. Draw wand down behind head and across shoulders. This gives a good stretch to the pectoral muscles in front and shortens the posterior neck and upper back muscles.

4. *Abdominal exercises.* In preventive work special emphasis should be placed on real abdominal exercises. Too many teachers give "trunk forward bend" for an abdominal exercise. Leg raising and lowering (from the supine lying position especially) is considered an abdominal exercise. Because of the weakness of the average individual's abdominal muscles, special emphasis should be given to the development of strong abdominal muscles. Hanging from the horizontal ladder (or outer rung of the stall bars) and raising legs forward is real abdominal work. Because of the key position of the abdomen and lower back in posture, abundant strength is necessary throughout this area to preserve the correct abdominal position and pelvic tilt. Correct pelvic obliquity must be maintained throughout these movements.

5. *Rest Positions.* The favorable rest positions have been enumerated (page 128).

6. *Balance Exercises.* These produce best postural results when the body is placed in a position of good body mechanics. Squatting and working on the balance beams produce the poise and balance desired in correct carriage. Flexibility should be mentioned in this connection. The Danish system of flexibility exercises has much to offer in the way of posture work. The ease and freedom of movement which can be secured from flexibility and balance exercises readily recommend these exercise types for the prevention of bodily defects and faulty body mechanics. Poise and balance are essential if one is to maintain good body mechanics.

7. *Foot Exercises.* These are explained in detail in Chapter VI.

8. *Large Muscle Activities.* These are essential for the hygienic effect on the entire body. With the use of large muscle groups in well known activities such as running, leaping, etc., there is a relatively small nervous expenditure.

9. *Rest and Breathing Activities.* Exercises Number 2 and Number 5 make an ideal activity.

10. *The Game Activities* have been discussed on page 130.

III. CORRECTIVE PHYSICAL EDUCATION ACTIVITIES

Prior to outlining the program for each type of faulty antero-posterior condition it is well for the reader to have a better idea of the types of exercises which are generally considered as body mechanics exercises. The list given is by no means an exhaustive treatise on exercises of this type, but is offered as a supplementary list to be used in connection with the types of exercises mentioned for use in specific cases.

A suggested list of physical activities for faulty antero-posterior cases:

1. *Crampton's "Air Push."* [1] This is a static exercise which appeals to one's imagination. The exercise is performed by pressing down with the palms of the hand while the chest is lifted. At the end of the downward push of the hands, the arms and hands are allowed to relax but the chest is held high. With proper control of the pelvic tilt and with the fingers pointing to the rear on the push, a good posture may be secured.

2. *Crampton's "Side Lift."* Arms are at side shoulder level position with palms up. The exercise is performed by imaginary "lifting" or pressing up with the palms (arms and hands do not move). The chest is raised, and the head is held up.

3. *Crampton's "Wrist Lift."* Finger tips are on shoulders, and the wrists and elbows are at shoulder height. The movement is an imaginary lift of the wrists (static movement).

4. Crampton has a number of other static exercises of like nature, *e.g.*, "Fist lift," "Elbow lift," etc.

5. *Crampton's Neck Massage* (*Modified*). This is an ideal exercise for actually exercising the neck muscles. (The majority of so-called neck exercises are simple head rolls with very little exercise involved.) His neck massage is as follows:

   a. Allow the head to relax forward until the chin is on the chest.
   b. Raise the head, look upward, and press far back.
   c. Hold this position, emphasizing it as vigorously as possible. The pupil should try to look at the back of his head.

6. *Crampton's Front Wall and Back Wall Tests.* Both are ideal exercises for teaching the individual what is correct body mechanics.

7. *Self-correction Before a Mirror.* The student is placed in front of a three-part mirror. He is then, by manual correction, placed in a correct position. He is then allowed to slump. He attempts to make his own correction. The instructor assists where necessary. Progression is made by walking and exercising with the correct body mechanics constantly maintained.

[1] Crampton, W. C., *The Pedagogy of Physical Training*, p.89, Macmillan Co., 1922.

8. *Passive Hanging from Horizontal Bar, Horizontal Ladder, or Stall Bars.* (The hands should be thirty inches apart. This favors a good chest position.) Keep the head well back and the chin in.

9. *Active Hanging.* Chin the bar.

10. *Hanging.* Instructor presses against the convexity of the exaggerated dorsal curve.

11. *Trunk Circling.* Standing with feet apart and hands on hips. (a) Bend trunk sideward, (b) swing it forward from hips (chest facing floor), and (c) come up on opposite side. Repeat in opposite direction.

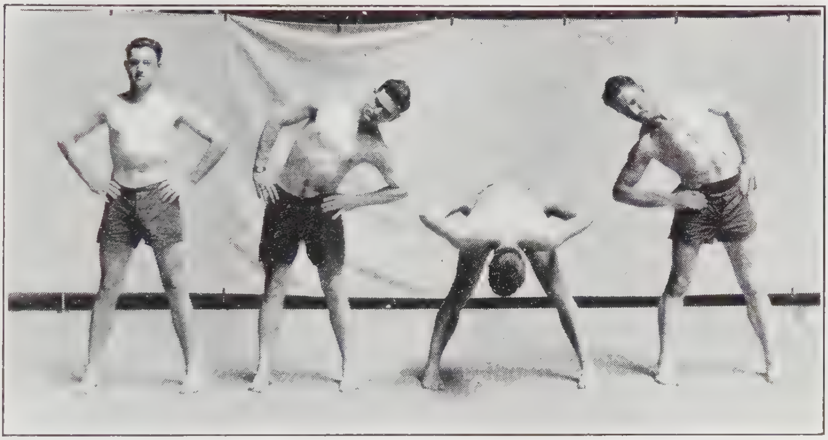

FIGURE 26

Trunk circling

12. *Trunk bending* forward with arms extended to side shoulder level position. (Palms up.)

13. *Squatting.* Hands may be placed on hips, at sides, or at "neck firm" position. Back held erect, head up, and chest held high.

14. *Windmill.* Standing with the feet apart and arms raised sideward at shoulder level. Twist trunk to right side, bend the trunk forward and touch the right foot with the left hand. (Knees are straight.) (The right arm is stretched straight up over the body and the right hand is pointing toward the ceiling.) Exhale. Return to original position and repeat to opposite side, *i.e.*, touch left foot with right hand and point left hand toward ceiling.

15. *Wand Exercises.* These may be used to advantage if correct body position is constantly maintained. Many students have the bad habit of thrusting the head forward as the wand is placed behind the shoulders. The head must be held well back during this movement.

16. *Abdominal Exercises.* These exercises of a vigorous nature should be given as soon as the student can endure this type of work. Weak abdominal muscles are serious obstacles to good body mechanics.

17. *Lunges with Arm Flinging to Side Shoulder Level.* These are useful if the chest is held high and the head erect. Care must be exercised to prevent the student from assuming the hollow back position during the lunge.

18. *Stationary running.* A high knee action and a light footfall is productive of greater effort and subsequent deeper respiration than the

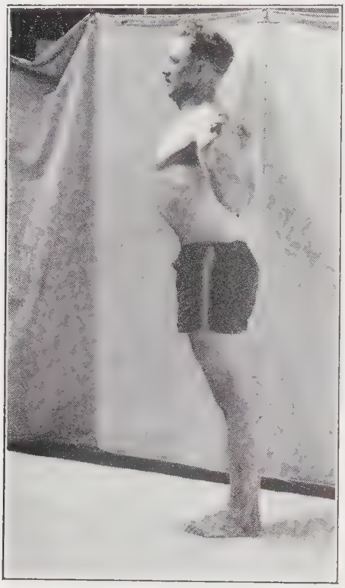

FIGURE 27
Correct wand position

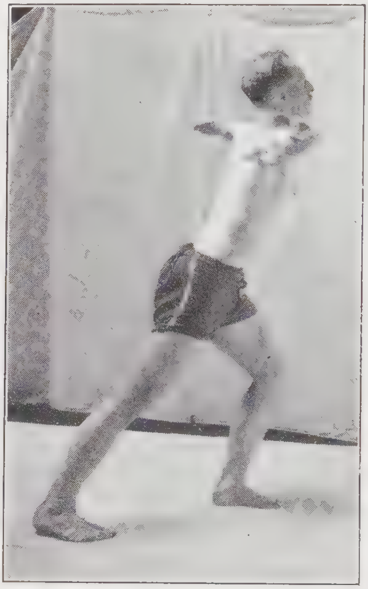

FIGURE 28
Correct lunge position

common stationary run where the knees are only slightly elevated and all the effort is given to pounding the floor with the balls of the feet.

19. *Corner Exercise.* The student stands in a corner with one hand on each wall, arms shoulder level, palms forward, and fingers touching the wall. Slowly let the body weight go forward and force the chest into the corner. (The elbows are kept straight and the abdomen is held in.) This gives the pectoral muscles a wonderful stretch. Care must be exercised to see that the head is not thrust forward. Return to original position. If pectoral muscles are put on too much tension, stand closer to wall at first. Progression may be made by rising on toes and forcing the chest into the

FIGURE 29

Corner exercise

FIGURE 30

Showing action of arm extensor and shoulder retractor muscles

corner. More care will be necessary to make sure that a good body position is maintained throughout the movement.

20. *Trunk Raising Against Resistance.* From a "trunk forward bend" position the student returns to the correct standing position against the resistance which the instructor gives as he places his hand on the student's upper back.

21. *Shoulder Blade Exercise.* Face the chest weights machine. With handles in hands at front shoulder level, slowly draw arms back to side shoulder level position. (Keep head back, chest up and abdomen in.) This type of exercise should be offered in place of the common type of working at wall machines with the back toward the exerciser.

22. *Squatting at Stall Bars.* Place the feet eighteen inches apart on the third bar from the bottom, hands grasping bar (hands wide apart) at shoulder level, body erect and arms straight. Bend the knees until the buttocks rest on the heels. Exhale. Rise to original position, first drawing abdomen well in and tightening the buttocks. Finish with the chest up and the lower back straight. (This exercise is contraindicated in all cases of knee disturbances.)

23. *Trunk Flexion from the Supine Position.* Lie on back, with legs straight and hands above head on floor. *Draw abdomen in* and sit up. Reach over toes with fingers and exhale. Return to original position by placing hands on abdomen and allowing lower back, then shoulders and finally the head to touch the floor. Stretch arms above head on floor and inhale. The exercise may be made more difficult if the return to the lying position is made by stretching both hands above the head and slowly lowering the trunk to the floor, allowing lower back, then shoulders, then head and finally the arms and hands to touch the floor. Additional progression is made by having the knees bent and the heels close to the buttocks as the student sits up. The return is then made by stretching the arms above the head as the trunk is lowered. (*Contraindicated if hernia exists.*)

24. *Breast Stroke.* Lie face down on the floor, a pillow under the abdomen. Do the breast stroke swimming with the arms. This exercise is conducive to the best shoulder posture when the arms are rotated outward as they are swept down toward the sides of the body. This movement should be performed very slowly.

25. *Shoulder Girdle Exercise.* With the body in the correct standing position, clasp the fingers behind the buttocks and rotate the arms outward as the shoulders are drawn down and back. A very vigorous progression is made by performing this same exercise from the prone lying position.

26. *Arm Rotation from the Long Sitting Position.* Sit with the back against the wall, the legs resting on the floor and the arms straight up over

head. Draw the arms slowly downward (rotating them outward) and keeping the trunk against the wall.

27. *Knee Circling.* Lie on the back, the knees flexed on the chest, the hands at "neck firm" position. Circle the knees across the abdomen to the left side of the body, then down, then to the right side and back to original position. Repeat in opposite direction.

28. *Various Arm Movements, Knee Flexions, etc.*, may be done from the lying position.

A. General Fatigue Slump Cases

A number of individuals present a dejected appearance due to their habitual slump. Their body mechanics rating is between "C" and "D." For this group ample rest and proper diet must be provided. The type of exercises for the fatigue slump group is the same as for the preventive group with, of course, stronger emphasis where this emphasis is needed. For the relaxed abdominal type, slow progressive work is necessary to build up good abdominal tone. A number of lessons will have to be devoted largely to correct lying position and strengthening of the abdominal muscles. A great deal of work will also be directed to developing organic vigor and skeletal tone.

B. Round Shoulders, Round Upper Back or Stoop Shoulders

These cases too, need rest, nutrition, and activity. The activity program should embrace the following types:

1. Correct body positions in lying, sitting, standing, and walking.
2. Correct breathing.
3. Chest raising and correct head position.
4. Abdominal exercises.
5. Rest with pillow under shoulder blades and hands at neck firm position.
6. Hanging with hands wide apart.
7. Posterior trunk movements.
8. Large muscle activities.
9. Rest and breathing combination.
10. Games with chest lifting and arm raising action. (Volley ball.)

Exercises for Round Shoulders, etc., in Detail:

1. *Correct Lying.* It may seem inconsistent to start on the abdomen when attempting correction of a shoulder condition, but in actual practice it will be found that the lower part of the trunk must be in proper position before lasting correction can be secured on the chest and head segments. Thus

the first exercise deals with proper pelvic position. The student lies on his back on the floor. His knees are bent, and his hands are at the sides. The exercise is that of abdominal retraction on exhalation, chest raising and good abdominal position on inhalation. It will be noticed that in doing this exercise, the chest is raised in a good position.

FIGURE 31

Showing hollow back

FIGURE 31-A

Correct lying

(Hands are placed at neck first to show flat back. Hands are ordinarily placed at sides)

2. *Correct Breathing.* Special emphasis should be given to the breathing in cases of poor shoulder positions, since vigorous respiratory movements banish round shoulders and flat chests. The best form of deep breathing is through the creation of the need for more oxygen, and therefore large muscle activities, such as running, are valuable. It is well, however, to warm up the parts by deep inspirations and forced expirations while the body is held in good position.

3. *Chest Raising and Correct Head Position.* In cases of faulty shoulder and head positions a great amount of emphasis should obviously be given to these types of activity. The arm movement of the breast stroke, as the student is lying prone on the floor, is conducive to a vigorous shoulder and head correction, providing the backward sweep of the arms is done with the arms rotated outward. A small pillow is placed under the abdomen to prevent a hollowing of the back.

Another movement is valuable for such cases. The student lies face down across a bench, with the trunk extended over the bench, the hips well supported, and the hands on the hips (progression is made by putting the hands at "neck firm" position). The trunk is slowly bent forward (not more than 45 degrees) and then slowly raised to the horizontal position again.

4. *Abdominal Exercises.* These must be vigorous enough to develop strength and endurance throughout the pelvic region in order that a stable trunk base will be habitual.

5. *Rest* (lying on the back) with pillow under shoulder blades and hands at "neck firm" position. The rest periods following the abdominal exercises can be productive of a vigorous correction throughout the shoulder region if the rest is taken in a position which favors correction. This rest factor should be so educational that the student uses the same principle throughout his inactive leisure time. In other words, he should rest with his body in a position which is most favorable to correct body mechanics. If he sits in a chair, he should sit UP rather than DOWN. His relaxed standing position should be balanced rather than slumped over on one side of his body.

6. *Hanging Exercises.* These are of great help in raising the chest and placing the head in a better position, providing the hang is an "active hang" and a *wide* grasp is taken on the bar. In the relaxed hang position, the body weight is hung from the fingers and hands. In the active hang position, the weight is ostensibly hung from the fingers and hands, but the body is in tone, the chest is raised, the head is held back and the abdominal and back muscles are active. When the hands are grasped at a width of thirty inches, the chest is expanded, and a favorable postural position results.

From this fundamental position various leg movements may be per-

formed. Alternate knees may be flexed or both knees may be flexed, thus giving the abdominal muscles additional work to do.

7. *Posterior Trunk Movements.* Posterior trunk and back muscles are usually exercised by arching exercises. When done correctly, this arching movement is confined to the upper back and neck muscles, but unfortunately, it is rarely done correctly. It usually results in a hollow back and a forward thrust of the head. To offset this danger, the following types of posterior trunk exercises are offered:

a. Stand, arms side shoulder level, palms up. Describe small circles backward, without swaying the body or the head.
b. Assume long sitting position. Use various arm movements from this position. (1) Sit with arms extended forward, fists clenched. Pull the arms and head horizontally backward. (2) Wand held behind shoulders, push up above head and pull down against resistance.
c. Stretch the spine. Place hands on the head and stretch head up against the hands. (This elevates the ribs.)
d. Bend head backward. (This may be done as "head raising" from prone position.)
e. Stand in a corner, arms side shoulder level, hands on wall. Force chest into the corner. (See page 136.)

8. *Large Muscle Activities.* These are especially needed in this group of round-shouldered and flat-chested individuals. By means of these large muscle activities, increased respiratory activity results, and the chest is raised. Also the hygienic effect of large muscle activities must not be overlooked. Increased organic efficiency aids in the promotion of better health; health and vitality are favorable to good body mechanics.

9. *Rest and Breathing.* These, following the heavier large muscle group activity, can be taken with the body in a position which is favorable to correction of the existing round shoulders.

10. *Games.* Games for this group should not be of the bending forward type. Backstroke swimming, volley ball, overhead relay, medicine ball throwing from the overhead position, etc., are especially good, and they are conducive to fun and correction at the same time.

C. Round Back

The basic use of rest, nutrition and activity must control this condition. The activity program for round back is as follows:

1. Correct lying, sitting, standing and walking.
2. Correct breathing.
3. Abdominal exercises.
4. Rest, with pillow slightly below middle of scapulæ.

5. Flexibility exercises. ("Windmill." Exercise Number 14, page 135.)
6. Hanging from stall bars (wide grasp).
7. Shortening of rhomboid muscles. (Wand exercises. See Figure 27, page 136.)
8. Large muscle activities.
9. Rest and breathing.
10. Games which cause vigorous reaching upward with arms.

D. Flat Back

This condition is rarely found in young individuals. When it does occur, it is accompanied by a number of complications such as round shoulders, forward thrust of the head, and general slumping of the body. Rest, nutrition and activity must be employed, and of the latter, the activities which are given for round shoulders and round backs may be adapted for flat backs as follows:

1. *Correct Lying with Legs Straight.* Correct standing and walking with proper pelvic tilt. The flat back type needs more pelvic tilt downward in front and upward and inward at the back.

2. *Correct Breathing.*

3. *Abdominal Exercises.* General abdominal weakness generally accompanies the flat back type.

4. *Rest.* This can be given in the prone position, without a pillow under the abdomen, but with a small pillow under the head.

5. *Hanging Exercises.* These with legs straight and the body in good tone make for flexibility.

6. *Arching exercises and Backward Bending of the Trunk.*

7. *Creeping or Wheelbarrow Walking.*

8. *Large Muscle Activities* (jumping jack, slap straddle, etc.)

9. *Rest and Breathing.*

10. *Games Which Are not too Vigorous,* but which tend to promote flexibility and poise.

E. Hollow Back and Bantam Posture

This type of faulty body mechanics is found in two types of individuals. (a) The student who has tried to correct his bad posture by throwing back his shoulders (bantam type, *i.e.,* stiff type) presents a hollow back. (b) The student who has allowed his body to slump generally shows an exaggerated lumbar curve or hollow back (lordosis). This latter type needs rest, nutrition, and special corrective activity. The "bantam" type needs, as a rule, only the special corrective activity. This activity for both is as follows:

1. *Correct Lying, Sitting, Standing and Walking.* Special emphasis will have to be given to these fundamental activities. The stiff type will find it more difficult to correct his exaggerated pelvic tilt than will the slump type, although the latter must develop enough muscle tone to correct his habits and to maintain the corrected position.

2. *Correct Breathing.*

3. *Chest Raising and Good Head Position.*

4. *Abdominal Exercises.* The stiff type will need to learn how to control the abdominal muscles in the correct position (retracted), while the slumped type will need to develop abdominal strength as well as to change his abdominal posture habit. Because of the shortening of the psoas muscles in leg raising, this abdominal exercise movement should be temporarily supplanted by the trunk raising from the supine position. (See Exercise Number 23, page 138.)

5. *Rest on Back, with Small Pillow under Hips.*

6. *Bicycle Movement.* The legs perform the bicycle pedaling movement while the body is in the supine position.

7. *Long Sitting Exercise.* Sit on table or on floor, with legs straight, body in good position, and bend at hips and not at waist. Perform various arm and trunk exercises from this position.

8. *Large Muscle Activities.* The "Windmill" exercise is a good example of the lighter form; running or leaping are examples of the heavier forms.

9. *Rest and Breathing.*

10. *Games.* The sitting type (long sitting or Turk sitting) of game corrects the hollow back position.

F. Round-Hollow Back

The round-hollow back is the more common type of postural deformity. The slump type is much more common than the stiff type of round-hollow back (bantam). Again, regulation of rest, nutrition and activity are essential in the treatment of these conditions. The activity program is as follows:

1. *Correct Body Positions* in lying, sitting, standing and walking.

2. *Correct Breathing.*

3. *Chest Raising and Correct Head Position.*

4. *Abdominal Exercises.* Emphasis should be placed on the necessity for keeping the lower back on the floor during all abdominal exercises. An additional effort should be made to train the student to hold his lower back on the floor as the arms are raised above the head to the floor. The action of the lattisimus dorsi muscles generally lifts the lower back unless vigorous shortening of the abdominals, gluteals and a static extension of the erector spinæ muscles resist the movement.

5. *Rest.* The rest should be taken on the back, with a small pillow under the hips, and the hands at "neck firm" position.

6. *Flexibility and Hanging Exercises.* The hanging exercises should be active hanging with knee and leg raising to stretch the lower back muscles.

7. *Shortening of Rhomboid Muscles.* With arms at side shoulder level, describe small circles backward.

8. *Large Muscle Activities.*

9. *Rest and Breathing.*

10. *Games.*

G. Scoliosis or Lateral Curvature of the Spine

Scoliosis comes from the Greek word meaning "twisting" or "bending." Dr. Lovett describes it as, "A condition in which any series of vertebral spinous processes show a constant deviation from the median line of the body, a deviation always accompanied by an element of twisting."[1] In rotation of the vertebral bodies the direction is toward the convexity, the spinous processes rotating toward the concavity.

FIGURE 32
Postural scoliosis

There are two types of scoliosis, postural or functional, and structural.

Postural scoliosis disappears when the student is lying or when he is suspended. It is a muscular condition, which, though not serious, often persists, if uncared for, until it becomes a structural or fixed curvature. In structural cases, the curvature does not disappear when the student is lying or when he is suspended. In one whose bone tissue is not healthy, there is great danger of marked postural deformity.

a. *Causes of Postural Scoliosis.*

(1) The frequent assumption of an asymmetrical posture. This results in a shortening of the muscles on one side of the body and a subsequent lengthening of the muscles on the opposite side of the body. Faulty school seats which cause children to assume one-sided positions must naturally be regarded as contributory causes of postural scoliosis.

(2) General bodily weakness. The child who has just recovered from a debilitating illness is more likely to fatigue quickly and thus start a pernicious posture habit. The child who is fatigued, often bears his weight on one

[1] Lovett, R. W., *Lateral Curvature of the Spine and Round Shoulders,* p. 51, Blakiston and Co., Philadelphia, Pa.

foot (usually the right) and develops thus a habit which, if not broken, results in a total "C" curve left.

(3) Errors in general hygiene.

(4) Defective reciprocal innervation of antagonistic muscles.

(5) Recreational and occupational habits. (Roller skating on one skate, riding a scooter or pushing a wagon with one foot.)

b. *Examination for Postural Scoliosis.* In addition to the examination items listed for "Examination for Faulty Body Mechanics" (page 112), the following should be carefully checked:

(1) It is absolutely necessary that the student's back be exposed to a point at least six inches below the crests of the ilia.

(2) Determine whether a curve exists. This may be done by a thread screen or a plumb line dropped from the seventh cervical to the depression between the back of the hips.

(3) If a curve exists (*have X-ray pictures taken of all curvature cases in individuals over eleven years of age*), note any unevenness in the

(a) level of the shoulders,
(b) inferior angle of the scapulæ,
(c) crests of the ilia,
(d) right and left sides of chest,
(e) right and left sides of upper back.

(4) Note the outline of the two sides of the body. In a left total scoliosis, the right side of the body will present a more marked concavity than the left side. The hip will be more prominent on the right side of the body.

(5) Note the general muscle tone of exposed parts.

(6) Have the student bend trunk forward. If curve does not straighten in this position (*or when lying down*) it is a *structural* curve and should be referred to an orthopædic surgeon.

c. *Treatment for Postural Scoliosis.*

(1) Education. The same educational principles apply in the treatment of postural curvatures of a lateral nature as in the treatment of faulty body mechanics of an antero-posterior nature.

(2) Rest and proper diet. These two factors are necessary to build up the body to a point where it can maintain any correction which may be secured by exercises or bracing. Fatigue must be prevented, even in some cases at the cost of lightening school programs.

(3) Removing the cause. Where faulty seating is the cause definite steps must be taken to correct the seating. When the cause is not removable, the effort must be made to prevent further deformity. For example, in a case where the curvature is due to a short leg, the sole of the shoe must be made thicker.

(4) Restore muscle balance by

(a) thoroughly teaching the student what is his correct body mechanics position;

(b) providing ample opportunity for practicing this correct position;

(c) braces (where prescribed by an orthopædic surgeon).

(5) Corrective exercises to strengthen the muscles and increase organic vigor so that the student may maintain the correct body position. The following is a list of exercises for scoliosis. The use of these will depend on the needs and capacity of the individual.

(a) Determining the key position. In a total left curve, the probable key or correcting position would be that of the right hand extended above the head and the left hand reaching down toward the left knee.

(b) Carrying of five, ten or twenty pound weights on the depressed shoulder.

(c) Hanging from the horizontal ladder or outer bar of stall bars and swinging, straight legs from waist to left side, for total curve left (right side for total curve right).

(d) For total curve left. Place both hands above head, feet together.

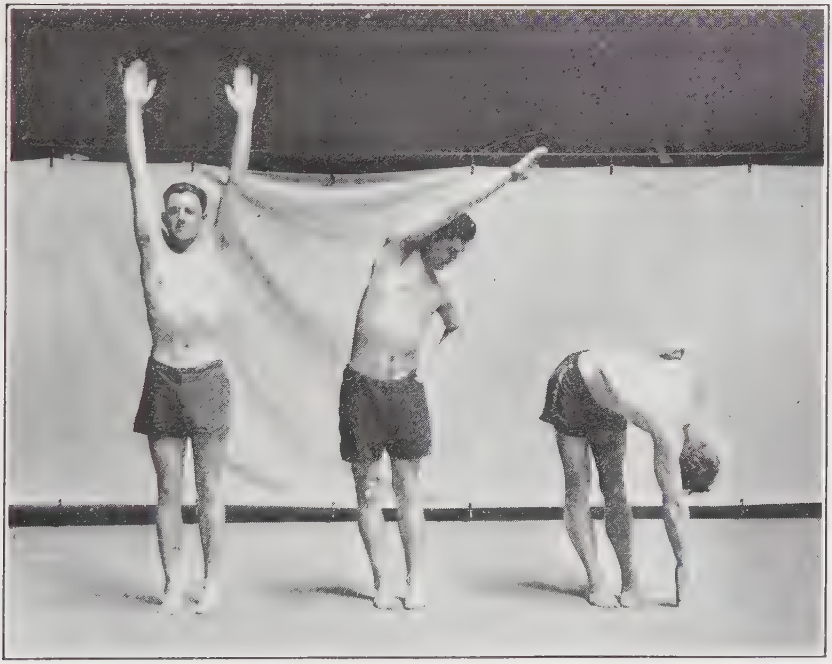

FIGURE 33
For total left curve

Twist the body to the left side, place the left hand on the left hip, and, still maintaining the twisted position, keep knees straight and bend body over the left side of the body until the right hand touches outside of left heel. Recover to the erect position by reaching out with the right hand. Twist to front; lower arms to sides. (Figure 33.)

(e) For total curve left. Stand with both feet apart, arms above head. Reach out in a wide circle effect with both hands, until hands reach position at sides of body; then continue circle movement of both arms, swinging the right arm across the front of the body and reaching out beyond the left

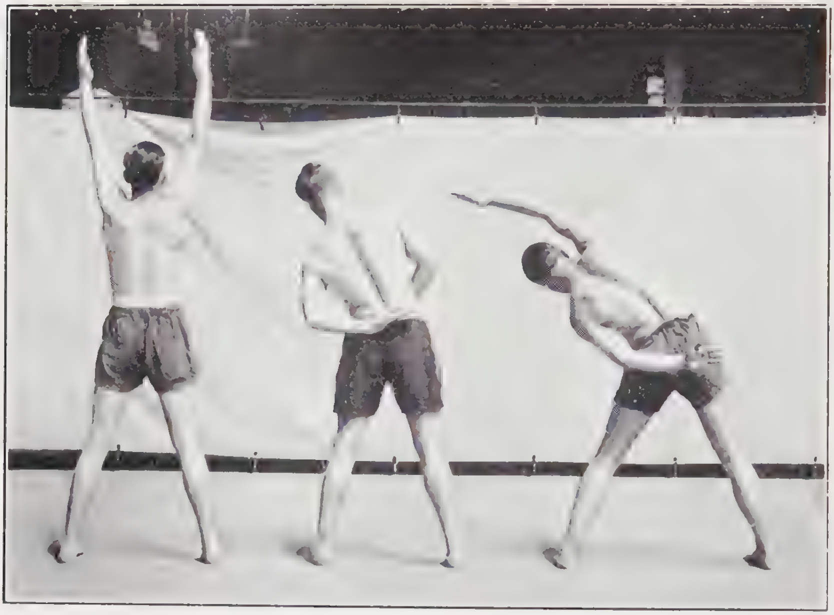

FIGURE 34
For total left curve

shoulder as the left arm continues across back of body toward the right hip. Now bend the body to the left side. (Figure 34.)

(f) For total curve left. Stand with feet well apart, arms at side shoulder level. Slowly swing right arm up above head and over to left hand, bending trunk to left.

(g) For total curve left. Lying on the right side on the floor, feet supported. Place the left hand on the left hip and the right hand behind head or above head in line with body (parallel with floor). Now bend the trunk up from the floor.

(h) For total left curvature, tennis (if student is right-handed) is an

ideal corrective game. For right total curve, right-handed bowling is recommended.

(i) For total right curvature. Sitting on a low stool, place the left hand on the back of the neck and the right hand on the convexity of the curve. Stretch the body as tall as possible, and then bend to the right side.

(j) For total right curvature. Lie prone on a pillow with the arms at the sides of the body. Raise the right arm up from the floor as the left arm is swung out to the left side and forward to a position in line with the body and parallel with the floor. Any number of variations can be devised from this lying position. The purpose is to correct the faulty muscle development and to develop sufficient muscle strength to maintain the correction.

Any number of variations of regular calisthenic exercises can be used for postural curvatures providing the movements are of a nature which correct the faulty muscle balance and strengthen the body so that correction can be maintained.

A typical exercise program for a total left postural curvature is as follows:

1. Correct lying position. Same as for antero-posterior conditions, except right hand is behind neck and left hand is at side.
2. Flexibility exercise. Light body bending.
3. Abdominal exercises. Arms must be in positions which favor correction of curve, *e.g.*, right hand above head on floor, left hand at side.
4. Rest. The rest is taken in the key position for correction.
5. Hanging exercises with emphasis on the correction of the curve. The right hand is higher than the left.
6. Prone lying or side lying to correct curve. (See exercises "g" and "j" for right total postural curvatures. Reverse positions and directions of movements to use for left total curvature.)
7. Rest.
8. Large muscle activities, *e.g.*, jumping back exercise. Little emphasis is placed on local correction. Hygienic effect is sought.
9. Rest and breathing.
10. Games. Volley ball, tennis, etc.

Structural Scoliosis.

Where the bone tissue has changed in contour, very little correction, if any, can be secured by the use of corrective exercises alone. It is necessary in cases of structural scoliosis to give exercise ONLY under the ADVICE of an ORTHOPÆDIC SURGEON. Structural scoliosis brings out very clearly the need for preventive work in younger children. Case after case of structural

scoliosis for which very little can be done through exercise alone could have been corrected very easily while in the postural stage. Most of the work which physical educators attempt to do on cases of severe structural scoliosis is futile. In connection with proper bracing, however, exercise is one of the most valuable physiotherapeutic agents in the treatment of structural scoliosis. (Figs. 35, 35a, 35b, 35c, 35d, 35e, 35f.)

FIGURE 35
Marked structural scoliosis

FIGURE 35-A
Structural scoliosis (Back view)

FIGURE 35-B
Structural scoliosis (Front view)

a. *Causes of Structural Scoliosis.*

(1) The persistent assumption of an abnormal position causing abnormal muscular contractions on one side of the body and consequent bending and twisting of the spine. This is the outstanding cause.

(2) Subnormal tissue. This is an almost parallel cause. In cases of infection and debilitating illness which lower the body's resistance, a slight lateral deviation of the spine rapidly becomes a marked structural scoliosis. Many structural scoliosis cases show a history of infantile paralysis.

(3) Superincumbent weight on abnormal tissue. If there is a slight deviation from normal posture, this superincumbent weight increases the spinal distortion.

FIGURE 35-C
Structural scoliosis
(Maximum correction without use of apparatus)

FIGURE 35-D
Marked scoliosis
(Student was unaware of any abnormal condition until he was examined by the college physician)

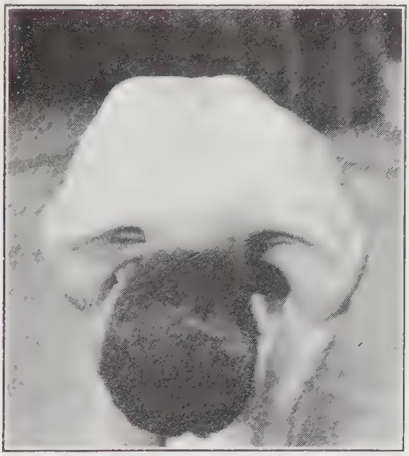

FIGURE 35-E
Same case as Figure 35-d. Structural deformity seen as body is bent forward

FIGURE 35-F
Same case as Figure 35-d. Key position for voluntary correction

(4) Occupations which demand unilateral body action, such as boxing, fencing, desk work, painting, etc.

(5) Careless use or abuse of leisure time, such as physical inactivity and lowered bodily resistance, or reclining on one side in reading, etc.

FIGURE 36
X-ray of scoliotic spine

(6) Anatomical defects, such as short limbs, sacralization of the fifth lumbar vertebra, accessory rib, etc.

(7) Injuries and amputations. (See Fig. 36, X-ray of spine of twelve year old girl. History shows severe fall on back when child was six years of age).

b. *Examination for Structural Scoliosis.*

The various examination items listed under "Examination for Faulty Body Mechanics" and "Examination for Postural Scoliosis" apply in the examination for structural scoliosis, plus the following items:

(1) Note whether the curvature is
  (a) simple structural (only one region of the spine affected).
  (b) compound structural (more than one part of the spine affected).

(2) Note bulging on one side of the front of the chest and a similar bulging on the opposite side of the back. Thus in a right dorsal structural curve, the right side of the back and the left front of the chest will show prominences, while the left side of the back and the right front of the chest will be depressed. The bulging on the back is called a prominent scapula and is due to the rotation which accompanies structural scoliosis.

(3) Note flexibility of spine. Determine how much "self-correction" is possible. Flexibility is usually more marked as the body is bent in the direction of the curvature.

(4) Note muscle tone. Flexibility without good muscle tone often leads to further distortion.

(5) Accurately record extent of deviation of spinous processes from median line. The thread screen or a plumb line is fairly satisfactory for this procedure. The X-ray picture is the ideal record in structural scoliosis. A two-inch strip of adhesive plaster, applied to the spine from the third cervical to the anal fold, may be marked to show the deviation of the spinous processes. In some systems an examination card with the back view of the head and trunk, is used. The deviation of the spinous processes is noted on the picture on the card.

c. *Treatment of Structural Scoliosis.*

Cases of structural scoliosis in younger individuals are amenable to correction if the case is not one of long standing. In cases of single curves (simple structural curvatures) the prognosis is more favorable than in compound curvatures. The treatment for structural curvature is a long process and should follow these general rules:

(1) Work should be done only under the advice of a physician. A physical educator should refuse to treat any cases which will not submit to a careful medical examination.

(2) The same educational principles apply to structural curvatures of a lateral nature as to faulty body mechanics of an antero-posterior nature. The student must know what is expected of him, and he must be willing to coöperate with the instructor.

(3) Where there is abnormal bone tissue or lowered resistance or weakness throughout the body, proper rest and diet are necessary. A cast or brace may be used during the rest period to assist in correcting the deformity, although the use of a cast or brace without suitable correction maintaining exercises is not a good practice.

(4) If the cause of the condition still persists and can be removed, this should be done without delay. This case is primarily for the orthopædic surgeon.

(5) Balance should be restored throughout the body by,

a. Correction of the deformity by braces or casts. (These are to be prescribed by an orthopædic surgeon.)

b. Strengthening the corrected structure so that correction can be and is maintained. (This is done only under the direction of the orthopædic surgeon.)

(6) Corrective exercises should be used.

In severe cases exercises are prescribed by the orthopædic surgeon as a preliminary to forcible correction, and also during this correction in order to maintain sufficient muscle tone and strength to render the correction more stable. A continued improvement is the best criterion of satisfactory exercise treatment. Bucholz [1] speaks of exercise in the treatment of scoliosis as being useful in the following ways:

1. For loosening contractures.
2. For developing muscle.
3. For postural correction.
4. For hygienic uplift.
5. For actual correction—if the exercise is done with proper technic.

The following is a list of exercises which have been frequently used for structural scoliosis. Some were used in connection with brace and cast correction. (The braces are removed when exercises are taken, and after a tonic bath are again applied.)

(a) All the exercises listed under "Postural Scoliosis."

(b) Student "spring sitting" on stool (for left dorsal and right lumbar or for simple curve left). Place the right leg forward and bend it at a right angle, stretch the left leg to the rear, and extend the right arm forward in line with the body. Bend the body slightly forward (45 degrees), and stretch the right arm in line with the body. Extend the left heel backward, in line with the body. (See Fig. 37.)

(c) Exercise for right dorsal curve. Sit on a stool, with the pelvis fixed.

[1] Bucholz, C. H., *Therapeutic Exercise and Massage*, p. 279, Lea and Febiger Co., Philadelphia, Pa.

Lift the trunk as high as possible and lean slightly forward. Swing the left arm to the front of the body and across the chest as the right arm is swung to the rear of the body and across the back.

(d) Exercise for right dorsal and left lumbar curve. For this curve it is necessary to use the left arm to correct the dorsal curvature and the right leg to correct the lumbar curve. This principle of arm movements for dorsal and leg movements for lumbar curves will, though not effective in all cases, be found fairly accurate. The exercise is as follows: stand with the left foot on a stool, the right foot suspended just off the stool. Raise the left arm

FIGURE 37

"Spring sitting"

FIGURE 38

Arm and leg stretch for right dorsal and left lumbar curve

sideward upward over head as the right foot is extended about one foot to the right of the left foot. Stretch up with the left arm and reach down with the right heel. (See Fig. 38.)

(e) Exercise for left lumbar and right dorsal curve. (This curve is often exaggerated by standing with the weight resting almost entirely on the right foot.) Hop on the left foot. Increase work by flinging the left arm up above head with each hop.

(f) Various stretching and pulling exercises. These are devised by hooking the leg of the lumbar concavity over the end of the table (left

lumbar curve, hook right leg) and pulling up, in line with the body, on the arm of the dorsal concavity (right dorsal curve, pull up on left arm).

(g) Various hanging exercises. These are found corrective in their results when a slanting bar is used, or the hand of the low shoulder grasps the outside of the stall bars and the hand of the high shoulder grasps the next lower bar. From this position additional lumbar correction may be secured by swinging the leg or legs to the side which corrects the lumbar curve.

(h) Head suspension in the Sayre suspension apparatus. This will afford the maximum correction. But this apparatus should never be used by the student without the personal supervision of the instructor.

(i) Side leaning rest position. For right dorsal curve rest weight on right hand and outside of right foot. Allow body to relax, and then vigorously straighten the body. Progress by flinging the left arm up and overhead as the body is straightened.

(j) Sleeping position. As the majority of people spend almost a third of their time in bed, care must be exercised to prevent further deformity. In cases of lateral curvature it is best to sleep in the supine position. While this position does not correct the curvature, it is more favorable than lying on either side.

(k) One-half prone leaning rest position. Rest on hands and knees. For right dorsal curvature, place the right hand six inches in front of the right knee. The left hand is directly under the left shoulder. The hips are directly over the knees. Lower the chest to the floor and maintain the hand positions.

(l) Various calisthenic exercises. If one keeps in mind that in scoliosis the pelvis must be fixed, the bend should be against or on the convexity, the student must not be fatigued, and the spine must be stretched and un-rotated, or re-rotated, etc., he can employ various calisthenic exercises with very slight modification. The common exercise of lying on the floor and drawing both knees to the abdomen may be used for a right dorsal, left lumbar curve in the following manner: both heels are raised from the floor, and both knees are drawn over the left hip as the left arm is stretched above the head and on to the floor, in line with the body.

A typical structural curvature exercise program for left dorsal, right lumbar scoliosis is as follows:

1. Correct lying position. This is the same as for antero-posterior conditions, except right knee is bent and left knee is straight, and right hand is under neck and left arm is at side. This position is most favorable for correction of curvature and it also still allows the chest to be held high and the lower back to be placed on the floor.

2. Flexibility exercise. Stand, with both hands above the head. Lunge forward with the left foot, bend the left knee and swing right hand to left toe as left hand is placed on left hip. If the student's back is bare, the instructor can determine the adjustments in the student's position necessary for the greatest correction.

3. Abdominal exercise. Perform the bicycle (leg pedaling movement) from the supine position. Extend the right hand above the head on floor in line with body and reach the left leg higher than the right leg.

4. Rest. Key or correction position is taken in the supine position.

5. Hanging exercise, with emphasis on the correction of the curve.

6. Prone lying with corrective movement. Raise the body from the hips (hips and legs supported) and bend the trunk to the left side. A slight twist (right) of the trunk in this position further assists in the correction.

7. Rest.

8. Large muscle activities. Hygienic exercise such as jumping, wood chopping movement, etc., are valuable.

9. Rest and breathing.

10. Games.

The above program is, of course, subject to modification. The exercise tolerance of the individual, his necessary activity following exercise, etc., must all be considered in prescribing a program for the structural scoliosis case. The chief object of the exercise must be maintained correction. If the body is corrected but severely fatigued in the process, a subsequent slump will often cause an increase in the distortion. Final caution is given in cases of structural scoliosis, namely: These cases are only handled under the direction of an *orthopædic surgeon.* The physical educator can do more by working on postural scoliosis than he can by attempting to correct structural scoliosis.

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CHAPTER VI

THE FEET

The human body is frequently forced, by the demands of modern civilization, to adapt itself to habits and customs which are detrimental to the efficient functioning of its integral and component parts. The feet are treated perhaps the worst of any part of the body. From the time the baby is shackled with his first pair of shoes there is continuous abuse of the feet. Small in relative size, out of all proportion to the weight of the body which the feet must carry, they propel the body through millions of steps and through years of standing until death relieves them of their Herculean burden.

According to Morton, "Disorder of the feet is the most common and most widely spread form of physical impairment among civilized peoples to-day (with the sole exception of dental defects), and has already reached a stage where over three-fourths of the nation's youth enter adult life with an acquired weakness that may at any time develop into a source of actual disability."[1] Due to improper shoes, poor use of the feet, bodily weakness, and injuries of the feet and legs, very few people reach adult life with comfortable, efficient feet. Many well-groomed, nicely formed hands show little relationship with the cramped, deformed feet which are carefully hidden (like an ill-treated step-child) from the public gaze.

The foot of the savage who has not felt the pinch of civilized footgear is a serviceable means of locomotion and a much better pedal extremity than the weak, deformed feet which are found to-day among men, women, and children. Our exacting and advancing civilization, with its customs, conventions and hard unyielding surfaces such as concrete pavements, hard floors, etc., has forced man to use shoes and stockings. These shoes and stockings, while affording protection to the feet, at the same time restrict the normal foot action. The result of this abuse is foot deformity and discomfort for millions of individuals.

Corrective Exercises Alone Will Not Cure Rigid Flat Feet. This statement is made despite well-meaning claims to the contrary. A foot with an arch which has become flat and is flat even when no weight is put upon it cannot be cured by corrective exercises alone, though corrective exercises may

[1] Morton, D. J., "Evolution of the Longitudinal Arch," *Jour. of Bone and Joint Surgery*, 22:59-90, 1924.

assist other modes of treatment. To a flat foot which has been operated upon, corrective exercises will restore tone, strength, and balance throughout the body in general and to the foot in particular. To flexible flat feet in children, corrective exercises and proper supports prove very satisfactory in restoring proper function and strength.

The statement that rigid flat feet cannot be cured by exercise alone does not mean that corrective exercises are not of any use in the treatment of weak and *flexible* flat feet. There is urgent need for preventive and corrective physical education in the cases of weak feet—to prevent them from becoming flat feet. Physical education in the past has confined its corrective work to the treatment of very bad posture and flat feet. The emphasis should be placed on the prevention of these cases and the treatment of the feet *in danger of becoming* flat.

The terms "flat" and "weak" feet are often used to mean the same thing and often lead to misunderstanding. A weak foot and a flat foot are both mechanically weak, but all weak feet are by no means flat feet. An examination of the average school group or a group of army recruits will show seventy-three to seventy-eight per cent. having weak feet (*but not flat feet*). The numbers having true flat feet or sunken arches will average from six to thirteen per cent. From the above figures it is easy to decide where the greatest effort for preventive and corrective physical education should be placed.

I. ANATOMY OF THE FOOT

A. Shape of the Normal Foot

In this day of deformed feet it is necessary to go back to the foot of the baby, or of the savage, to get a good picture of the normal foot. The normal foot is fan shaped, showing a relatively straight line from the heel to the inner side of the distal phalanges of the great toe. The arch on the inner side of the foot is concave, and on the outer side of the foot is slightly convex. All the toes lie parallel to each other. Meyer's line should pass through the distal phalanx of the great toe and back through the center of the heel. Feiss' line should pass through the lowest point of the internal malleolus to the plantar aspect of the first metatarso-phalangeal joint. This line bisects the tubercle of the scaphoid bone. These lines are used for the purpose of determining deviations from normal foot contour.

B. Mechanical Arrangement of the Foot

The foot, considered mechanically, is an elastic arched structure, with three points of support: the calcaneus bone, and the anterior heads of the

first and fifth metatarsal bones. There are twenty-six bones in the foot: the calcaneus (os calcis), the astragalus (talus), the scaphoid (navicular), the three cuneiforms (internal, middle and external), cuboid (these seven are called the "static" portion or weight bearing portion of the foot), five metatarsals (numbered from within outward), fourteen phalanges (three for each toe except the great toe which has two). The last nineteen bones are known as the "dynamic" portion or spring portion of the foot.

The entire foot is an elastic structure. It articulates with the bones of the leg through the astragalus. The body weight is transmitted to the posterior third of the foot through the astragalus. The functions of the foot are

a. to support the body,
b. to propel the body.

C. The Arches of the Foot

1. *Antero-posterior or Longitudinal Arch.* This is made up of two parts, both having a common posterior segment starting at the calcaneus. The inner segment of the longitudinal arch extends from the common posterior segment and is attached to the astragalus, the three cuneiforms, and the first, second and third metatarsals. The outer segment runs from the common segment to the cuboid and the two outer metatarsal bones.

The posterior segment of the longitudinal arch, which extends to the medio-tarsal joint, is short and very stable. It is well suited for weight bearing. In the passive standing position the greater part of the body weight should be borne on this segment of the long arch. In the active standing position the weight should be borne at a point slightly forward (over the scaphoid [navicular] bone). The outer portion of the anterior segment of the longitudinal arch is much lower and stronger than the inner segment. It is better adapted to weight bearing. The inner portion of the anterior segment of the longitudinal arch is higher and provides the foot with its spring.

2. *Transverse Arch and Anterior Arch.* Many texts mention the transverse arch without giving an accurate description of it. It is said to "extend across the foot from the heads of the metatarsals to the mid-tarsal region at the scaphoid."[1] The insertions of the tendons of the peroneus longus and the tibialis posterior form what might be termed a "transverse arch." The forward portion of the transverse or cross section of the longitudinal arch is also spoken of as the "transverse arch." To avoid this confusion of terms and to gain a definite working basis, the transverse arch is defined here as the anterior ends of the five metatarsals, bound together and arched by the interosseous and plantar ligament. The heads of the metatarsal bones, bound

[1] Taylor, R. T., *Surgery of the Spine and Extremities,* p. 393, Blakiston and Co.

together by the transverse metatarsal ligament, will be called the "anterior arch."

The arches mentioned above are further supported by the calcaneo-scaphoid, calcaneo-cuboid, long plantar ligaments, small ligaments, tendons and fascia. The action of the parts noted above is that of binding the structure together to prevent a flattening of the foot. The bones and their ligaments are the real supports of the body. The muscles are better classified as controllers of balance. There is, however, a certain element of support manifested by the tendinous insertions of the leg muscles on the plantar surface of the foot.

D. Chief Muscles of the Feet (Important Muscles Concerned With Weak and Flat Feet)

1. *Tibialis Anticus.*

Origin. The upper two-thirds of the outer surface of the tibia and interosseous membrane between the tibia and the fibula. It passes downward on the outer side of the tibia, and crosses to the inner side of the foot, in front of the inner malleolus.

Insertion. The lower part of the inner surface of the first cuneiform and the adjacent part of the first metatarsal.

Action. It lifts the foot in dorsal flexion and in inversion. This is a very important muscle in weak and flat feet. According to Lowman this muscle normally aids in holding the scaphoid strongly up against the head of the astragalus, but in relaxed cases (flexible flat foot) its pull is so far forward of the medio-tarsal joint that it actually becomes a deforming factor.

2. *Tibialis Posticus.*

Origin. The upper half of the posterior surface of the interosseous membrane and the adjacent parts of the fibula and tibia. It extends downward and passes behind the inner malleolus.

Insertion. The bottom of the inner surface of the scaphoid, first cuneiform and adjacent metatarsals.

Action. Plantar flexion, adduction, and inversion. This muscle increases the height of the arch and assists in supporting the astragalus.

3. *Peroneus Longus.*

Origin. The lateral condyle of the tibia and the upper half of the outer margin of the fibula. It passes downward and close behind the external malleolus and runs forward along the outer margin of the foot, across the groove in the cuboid bone.

Insertion. On the first cuneiform and the first metatarsal base.

Action. Plantar flexion and eversion of the foot. Owing to the peculiar diagonal course of this muscle (from cuboid across to first cuneiform and first metatarsal) this muscle tends to maintain the symmetry of the dome

of the arch of the foot. Failure of this muscle to function (plus a "giving way" of the plantar tie bands) results in a dropping of the dome of the arch and the flattening of the foot.

4. *Peroneus Brevis.*

Origin. Same as peroneus longus. It follows the peroneus longus behind the ankle.

Insertion. At the base of the fifth metatarsal bone.

Action. Same as peroneus longus.

5. *Flexor Longus Hallucis.*

Origin. The lower two-thirds of the fibula. It passes down the back of the tibia, behind the inner malleolus.

Insertion. At the base of the second phalanx of the great toe.

Action. Plantar flexion of the foot and of the great toe. It also assists the calcaneo-scaphoid ligament in supporting the arch. In cases where the great toe is wedged against the second toe (hallux valgus) this muscle tends to increase the deformity.

6. *Flexor Longus Digitorum.*

Origin. Posterior middle of the tibia and surrounding tissue. It passes over the posterior tibial tendon on the back of the leg, goes down behind the inner malleolus, maintaining the correct position of the calcaneus bone by upward pressure on the calcaneo-scaphoid joint.

Insertion. It is inserted by four tendons into the base of the last phalanx of each of the smaller toes.

Action. Plantar flexion of the smaller toes.

7. *Flexor brevis digitorum, gastrocnemius, soleus, adductor hallucis, flexor hallucis brevis,* and the other flexor accessories are all necessary for plantar flexion and normal foot action.

8. *Extensor Longus Hallucis.*

Origin. The middle front surface of the fibula. It passes across the upper or dorsum of the foot.

Insertion. Base of the last phalanx of the great toe.

Action. Dorsal flexion of the great toe. This action is commonly spoken of as "extending the great toe."

9. *Extensor Longus Digitorum.*

Origin. Lateral condyle of the tibia, the upper two-thirds of the fibula and down to the front of the ankle where it divides into four tendons.

Insertion. At the top of the four small toes.

Action. Extension of the smaller toes.

10. *Extensor longus digitorum, extensor longus hallucis,* with the *tibialis anticus* and the smaller extensors of the toes, are commonly called flexors of the foot. This interchange of terms "Flexors" and "Extensors" should be carefully watched to avoid confusion. These muscles are necessary for the

normal movement of lifting the toes and the front of the foot from the ground. Paralysis of these muscles results in a dropping of the foot.

II. MOVEMENTS OF THE FOOT

A. Dorsal flexion (commonly called flexion).
B. Plantar flexion (commonly called extension).
C. Abduction.
D. Adduction.
E. Eversion.
F. Inversion.

Dorsal flexion is accomplished by the tibialis anticus, peroneus tertius, extensor longus digitorum, extensor longus hallucis, and the other smaller extensor muscles of the foot. In dorsal flexion the upper portion (dorsum) of the foot is drawn toward the front of the leg.

Plantar flexion is accomplished by the gastrocnemius, soleus, tibialis posticus, peronei, and the other foot flexors (plantar flexors) mentioned. In plantar flexion the upper portion of the foot is drawn away from the front on the leg, *i.e.*, opposite to dorsal flexion.

Dorsal and plantar flexion take place on the axis known as the medio-tarsal or mid-tarsal joint (the points of articulation between the calcaneus and the cuboid, and between the astragalus and scaphoid bones). (See Figure 39.)

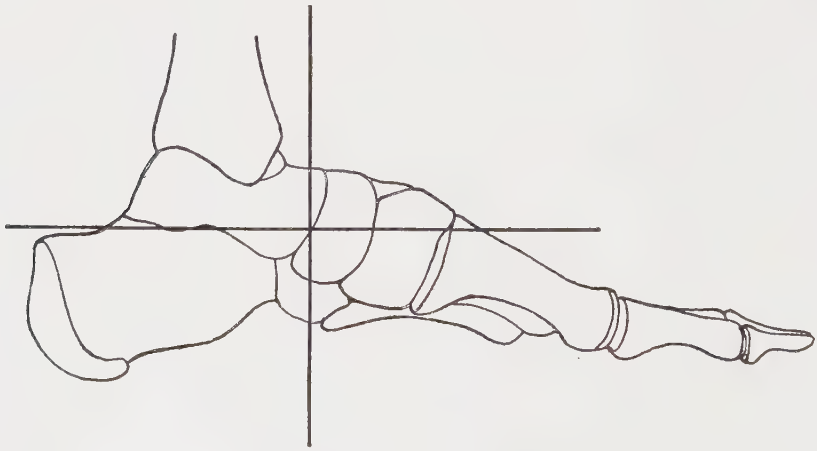

FIGURE 39

Medio-tarsal or mid-tarsal joint shown by vertical line. Sub-astragaloid joint shown by horizontal line

Adduction and *Abduction*. In adduction the forefoot is deflected inward from the medio-tarsal and subastragaloid joints. In exaggerated adduction we have the club foot. The two tibial muscles (tibialis anticus and tibialis posticus) are the chief adductors of the foot. In abduction the forefoot is deflected outward from the medio-tarsal joint. This occurs in flat foot. Both adduction and abduction take place through the medio-tarsal joint. (See Figure 40.)

Eversion and *inversion* are the natural results of abduction and adduction and are not considered as separate movements, though there is a definite

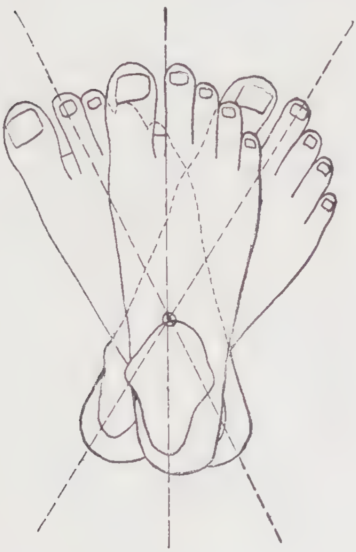

FIGURE 40
Adduction and abduction

FIGURE 40-A
Inversion and eversion

lifting of the outer border of the foot in eversion and a lifting of the inner border of the foot in inversion. True eversion without abduction is rarely possible, unless it is performed as a passive movement. Eversion and inversion movements take place through the subastragaloid joint.

Range of Movement

At the medio-tarsal joint the range of movement is usually from 60 to 80 degrees. Dorsal flexion in the normal foot is from 10 to 20 degrees less than a right angle. Thus with the knee straight and the foot placed flat upon the ground, the leg can be flexed forward on the foot (from 10 to 20 degrees), without the heels leaving the ground. This slight

degree of dorsal flexion is often productive of a sharp pain in the region of the ridge of the shin bone when walking up a steep grade. Plantar flexion is much freer and should be from 50 to 60 degrees more than a right angle

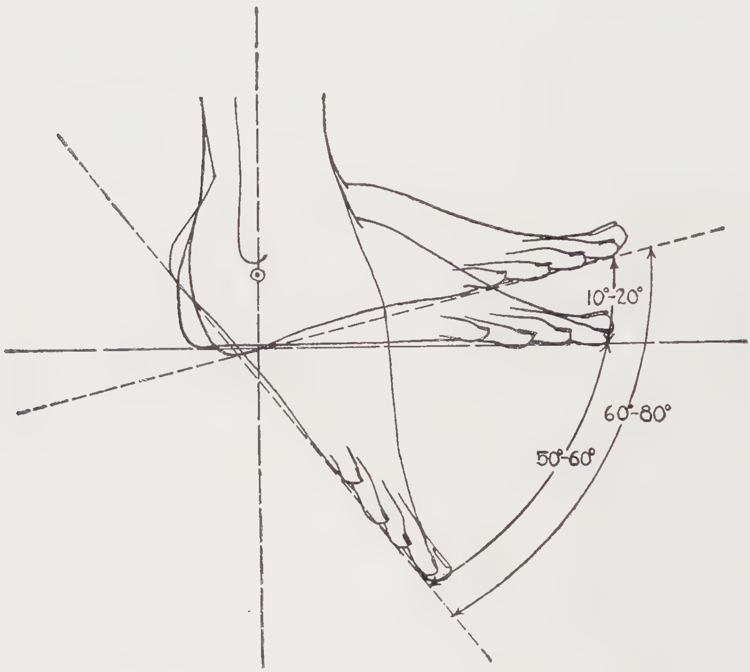

FIGURE 40-B
Range of movement

or from 140 to 150 degrees from a line drawn parallel with the leg. The normal range of movement is often found in weak feet. It is usually limited in flat feet.

III. THE FOOT IN WEIGHT BEARING

A. Passive Standing Position

The *usual passive* standing position is one with the feet turned out (everted and abducted). In this position the muscles are relaxed, and the body weight is borne on the inner portion of the foot. The balance of the foot is destroyed, and the dynamic or propelling portion of the foot is fatigued and cannot impart spring to the step. At first this position is

simply one of poor muscle balance and results in fatigue of the feet and of the body. (See Figure 41.)

This position is termed one of "poor leverage." It is best illustrated by the following example. Two five-pound bags of sand are held in the hands directly out in front of the body. This position is like the one attained when the feet are in the everted position, the body weight being borne over the inner sides of the feet. It can be held without fatigue for only a short time. The bags of sand are now placed one on each shoulder. This position

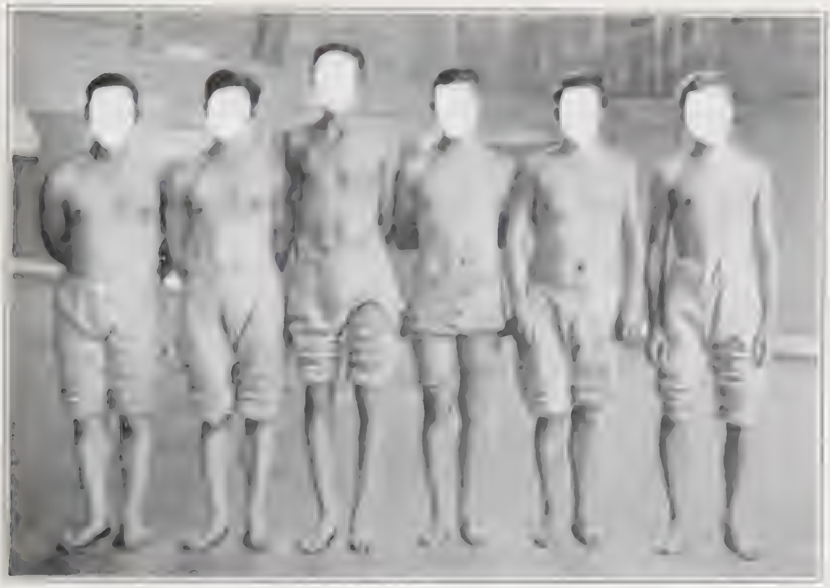

Figure 41

The usual passive standing position

is akin to the parallel foot position when the weight is borne by the posterior and outer portions of the foot not farther forward than a point between the scaphoid bones. In this position the weight is scarcely noticed.

If the abducted foot position is constantly maintained, the muscles of the feet and legs lose their power balance, the ligaments no longer support the foot and the arch properly, and the bones gradually change their positions. The calcaneus rotates inward, the astragalus slips forward, and the scaphoid bone is lowered until the arch becomes depressed when weight is borne. If this faulty position is still maintained, the foot gradually assumes the deformed position when weight is borne and even when weight is not borne. The foot becomes a true flat foot. (See Figure 42.)

B. Active Standing Position

The support of the arch of the foot is dependent upon three factors:

1. bones,
2. ligaments and plantar fascia,
3. tendinous portions of the muscles.

The muscles, however, are more important as factors of balance than of support. In the corrective active standing position the feet are parallel. The muscles of the feet and legs are in balance. The astragalus, though rotated slightly inward and downward on the calcaneus, is supported by the

FIGURE 42
Flat feet

ligaments on the inner side of the foot. The body weight is borne on the front part of the posterior pillars of the arches, between the scaphoid bones in the transverse plane and over a line drawn through the heel and extending forward and through the second toe in the antero-posterior plane. (See Figure 43. Compare with Figure 41.)

The weight is often said to be borne at a point between the internal malleoli bones. In this position, however, the entire body is not balanced as well as when the weight is borne between the scaphoid bones. The stronger calf muscles on the back of the leg must balance with the weaker muscles on the front of the leg, and this balance is obtained only when the weight is borne between the two scaphoid bones. This position balances the weight over the weight-bearing portion of the arch and allows the dynamic

of propelling portion of the forepart of the foot to perform its natural function. Bearing weight on the balls of the feet produces lumbo-sacral strain.

To understand properly this muscle balance one must recognize the fact that the posterior muscles are much stronger than the anterior leg muscles. Owing to the insertions of the posterior muscles (gastrocnemius and soleus especially) into the calcaneus, and the plantar flexors nearer the ankle than the dorsal flexors, a problem of leverage must be considered. When the weight-bearing position is placed slightly in favor of the weaker dorsal

FIGURE 43

Foot cases standing with feet parallel
(Same group as in Figure 41. Compare with Figure 41)

muscles, a balance between the posterior and anterior leg and foot muscles is maintained. This position of balance in the active standing position is maintained without undue fatigue because the shifting of weight allows for work and rest periods of the supporting structures.

C. Walking

There is a diversity of opinion as to just what is the normal walk. A few say that we should follow the example of a person walking over a surface which requires that each step be chosen with care, as, for example, a slippery

pavement. This means that we should place the toes to the ground slightly in advance of the heel. Others suggest that we should place the entire foot on the ground at once. The most commonly accepted conviction is that the "heel and toe" stride is the best.

The "toe and heel" stride must be given some consideration. Its exponents defend it for the following reasons:

1. The commonly accepted "heel and toe" stride is not the stride which one uses when forced to give attention to each step, as on slippery surfaces.

2. A runner does not let his heel strike the ground ahead of his toes. (It may be of interest to note, in this connection, that the runner turns his feet parallel as he gains speed.)

3. There is a correlation between the "heel and toe" stride and the foot difficulties, which are legion.

Our discussion must consider practical application, and it is generally recognized that the "toe and heel" stride is not practical for everyday use to-day. It is difficult in shoes which are strong enough to fulfill their duty of protecting the feet from injury. The savage who grips the ground with his toes, is walking on soft, non-resistant earth which molds itself to the irregularities of his feet and lessens the shock of the impact. The "heel and toe" stride *is practical* with our present conditions of non-yielding surfaces and strong shoes. It must not be overlooked, however, that the "toe and heel" gait, without shoes and on a soft surface, is an ideal foot exercise. As civilization advances, the necessity for an ideal and practical gait must be met. The common "heel and toe" walk must be perfected to the point where the foot difficulties arising from this gait are eliminated. Rather than condemn this gait and fail to offer a practical substitute, physical education must realize that the "heel and toe" walk is the one which is generally used and must and can be made safe for the feet.

The correct "heel and toe" walk is as follows: The feet are parallel. The forward foot meets the ground with the weight borne momentarily on the heel. The weight is then carried on the outer border of the foot (over the cuboid bone) and then to the metatarsal bones. As the body passes over the foot, the foot is dorsiflexed for not more than 20 degrees. The heel is then lifted, and the weight is borne momentarily on the temporarily depressed forepart of the foot. The combined action of the plantar flexors of the foot, and especially the flexor longus hallucis, and a slight separation of the great toe from the smaller toes, results in a pushing against the ground. This pushing action lifts the foot and starts it on its forward swing in preparation for the next step.

This correct "heel and toe" walk makes no undue strain on the muscles, ligaments, or bones, in the normal foot. The adductor muscles of the feet

are normally stronger than the abductor muscles. Years of "toeing out" and the resultant weakness of the adductor muscles which have not been used sufficiently, cause a feeling of "strangeness" in the correct position. This can be banished only by developing the habit of parallel foot position which will take the strain from the muscles of balance and allow the body weight to be distributed through the astragalus to the parts which are normally intended for support. This also allows the parts which have to do with spring and propulsion to function properly. Habitual exercise of the normal foot movements is necessary for the maintenance of correct balance of the opposing muscle groups and proper relationship between the strength of the supporting structure and the weight of the body.

The incorrect "heel and toe" walk (feet abducted and everted) is beset with many difficulties. The first is that of incorrect weight-bearing. The outer side of the heel strikes the ground, and the weight is distributed forward and inward over the inner arch. The inner arch loses its spring action and must now act as a weight-bearing structure. The forefoot is turned out from the medio-tarsal joint, and the normal flexor action of the toes is impossible. The foot leaves the ground from the inside of the great toe in a movement which is best described as a "shuffling gait." The second difficulty is that of undue strain on muscles and ligaments of the inner side of the foot and knee. The inward tilt of the calcaneus bone causes the astragalus to gravitate inward. The scaphoid is then depressed, and the ligaments on the inner side of the ankle and foot are depressed and stretched. A strain is felt on the inner side of the foot, and up to and including the ligaments on the inner side of the knee.

From the incorrect stride result not only faulty weight-bearing and strain but also disuse which leads to inefficiency and weakness of the parts involved. The muscles are not used in balance, and a derangement of the supporting structures of the body is imminent. If this gait is not corrected, the bones gradually become "fixed" in the faulty position and a sunken arch results.

The chief problem of corrective and remedial physical education is that of prevention. The everted foot and the weak foot present a muscle problem which, if not corrected, becomes a bone problem. The individual must be taught to use his feet correctly. Handicaps to normal foot use must be removed. These are largely a matter of education. Many children are still taught to "toe out," and girls are told that it is "unladylike" to walk with the feet straight ahead. Shoes which deform the feet are still "the style." The necessity for proper shoes must be stressed constantly. People must be educated to the fact that the straight foot position is the natural position. The parallel standing position and the parallel gait of the Indians who are noted for their endurance, the natural swing to the

parallel position when a runner gains speed all point to the parallel foot position as the one which is mechanically correct and least fatiguing.

IV. CLASSIFICATION OF FOOT CONDITIONS

There are three types of feet: the normal foot, the weak foot, the deformed foot. For clarity this classification may be further divided as follows:

A. The Normal Foot

This presents an arch which is neither unusually high nor low. This foot functions without strain in its two tasks of weight-bearing and propulsion. (See Figure 44.)

FIGURE 44
Normal feet

B. The Abducted Foot

This foot presents a picture of muscular weakness and poor mechanics but it is without pain or deformity. Corrective exercises for the feet and general hygienic exercises to tone the body should be given. The individual with abducted feet should be educated to the necessity for correct foot function.

C. The Weak Foot

The weak foot presents a structure which has been abused by improper use, incorrect shoes, or by injury. A combination of the three is not an infrequent cause. The weak foot has been strained, or is being strained. The muscles which are ordinarily used for balance are now being strained in bearing the weight of the body. The ligaments have been overstretched, and the weaker lateral ligaments on the inside of the foot are attempting to do the supporting which should be done by the stronger plantar ligaments. There is a slight derangement of the bones of the foot. This can be detected only in weight-bearing. The arch of the foot may not have changed its contour. Pain is often present during, or after exertion, and the patient may give a history of past pain. Inflammation is generally found where pain is present. All weak feet are not necessarily painful, however.

Careful examination may show the calcaneo-scaphoid and the deltoid ligaments to be under strain, due to the inward rotation of the calcaneus and astragalus. (See Figure 45.)

This type needs relief from faulty weight-bearing, rest until the painful symptoms have subsided, proper shoes, instruction in parallel walking, and exercises to strengthen the foot and leg muscles and to tone the body.

1. 2. 3. 4. 5. 6.

FIGURE 45

Showing poor and good foot positions

(Odd numbers are in poor positions; even numbers are in good positions)

D. The Flat Foot

(See Figure 42, page 168.)

In this type of foot the arch has fallen. Instead of the normal concavity on the inner border of the sole of the foot, a distinct convexity is seen. The types of flat foot must be further classified as follows:

1. Congenital. (Generally symptomless, though deformed.)
2. Acquired.
   a. Flexible. (Generally painful.)
   b. Rigid. (Generally without pain.)

The congenital flat foot, being without pain, very rarely causes its owner to seek to relieve the condition by exercise. The gait is clumsy and is often described as the "pedestal gait." Correction of this condition by exercise alone is quite rare.

The flexible acquired flat foot often forces its owner to seek relief from

the pain which accompanies this condition. The treatment of the flexible flat foot only partially concerns physical educators, for exercise alone will not cure this type. An arch support alone will not cure a flexible flat foot. The treatment of this condition will be discussed under "Treatment of Flexible Flat Feet."

The rigid acquired flat foot is not amenable to relief or cure by corrective exercises. General hygienic exercises for the improvement of the body functions will increase muscle tone throughout the entire body and indirectly do some good for the feet. But relief of the rigid acquired flat foot condition involves surgical manipulations, possible operation, correct shoes, and—only in connection with these—corrective exercises and proper walking.

E. Miscellaneous Foot Conditions

Under this heading are found club feet, deformities following paralysis and injuries, etc.

V. WEAK FEET

It will be seen from the above classification that the bulk of the work on foot conditions done in the corrective classes, will be with the weak foot cases. Waiting until the foot has become flat and then attempting to cure the condition is like putting on rubbers after the feet have become wet. The emphasis must be placed on preventing everted and abducted feet from becoming weak, and on preventing weak feet from becoming flat.

Faulty weight-bearing should be challenged by corrective workers. Here is a condition which CAN be successfully treated by physical education procedures. And surely teaching people how to stand and to walk correctly is far more valuable to the community than teaching a relatively few students how to jump six feet or more.

The weak foot must be considered as the result of a progressive breaking down of the integrity of the foot. This is due to improper foot function and a consequent interference with normal foot mechanics. Disorders of the feet naturally involve its mechanical function. Due to wrong distribution of body weight, normal foot movement is impaired. Due to lack of normal movement, a weakness results. In addition to the weakness there develops a disproportion between the strength of the supporting structure and the weight and strain which the structure must bear. The body weight is transmitted from the weight-bearing pillar at the posterior part of the long arch to the inside of the forepart of the foot. This shift results in faulty weight-bearing and poor balance. The structure, being out of balance, works at a mechanical disadvantage which is fatiguing. If this condition is not remedied, a bony change takes place and a true flat foot results.

A. Causes of Weak Feet:

1. Incorrect use of the feet.
2. Incorrect shoes.

B. Contributory Causes:

1. Injuries to lower leg and to foot.
2. Overweight.
3. Debilitating illness and subsequent bodily and muscular weakness.
4. Rickets.

A. Causes of Weak Feet

1. *Incorrect Use of the Feet.* The foot is intended for propelling the body and for supporting the body in the standing position. In the normal foot these two functions are performed with ease and comfort. But, unfortunately, from early childhood this position often gives way to a position of abduction and eversion. The foot is used at a mechanical disadvantage. A vicious cycle is established; the feet tire quickly, and the remainder of the body is fatigued, this general fatigue causes a slouching throughout the body. Thus the poor use of the feet results in poor use of the body which in turn produces additional strain on the overburdened feet. Soon the individual begins to accommodate his habits to his feet. He no longer runs when he can walk; he no longer walks when he can ride; he no longer stands when he can sit. A general weakness of the entire body results.

2. *Incorrect Shoes.* The Chinese bound their feet in an attempt to make them narrow and small. The Chinese knew what they were doing. But many Occidentals fail to realize that their faulty shoe fitting is deforming their feet and making them impractical for weight-bearing and locomotion. The persistent wiggling and toe curling in which a baby indulges when his parents attempt to put a shoe on him is significant as an unconscious rebellion against this deforming factor in his life. The average shoe worn by young children does not conform to the shape of the child's foot. The heel counter of the shoe is too large, and allows the child's heel to tilt inward, thus starting the disintegration process of the foot structure.

The adult's shoe is generally too tight and too short. This type of shoe interferes with, if it does not actually restrict, the circulation of blood and lymph. Many adults' shoes are too loose in the heel counter. A sudden strain of the foot, when it is called upon to bear an unusual burden, allows an inward rotation of the calcaneus bone and a subsequent strain throughout the arch and forepart of the foot. Too many shoes crowd the toes and turn the large toe toward the center of the foot, thus depriving the foot of the

natural push of the great toe in walking. Tight lacing binds the foot to a stiff shank and further interferes with normal foot movement. These factors, by disturbing natural function, lead to foot weakness.

The average person with weak feet is somewhat reluctant to wear so-called "corrective shoes," and, when questioned for reasons, usually gives the following:

a. Corrective shoes are ugly and stigmatize the wearer.
b. Corrective shoes cannot be bought in the average shoe store.

In the past, corrective shoes were heavy and unsightly, but to-day this objection is unfounded. A woman can secure a corrective shoe of patent leather or satin in which the corrective features are scarcely noticeable. A man, too, finds very little difference between the appearance of a corrective shoe and the broad toe type which is now being worn.

The objection that corrective shoes cannot be bought in every shoe store is partially correct. This objection will hold until more men and women are educated to the value and the need of correct foot apparel. As long as women are willing to vie with one another in their foolish attempt to secure the latest style in shoes, shoe manufacturers will supply this demand. As soon as the shoe manufacturer feels that when he manufactures corrective shoes women will buy them in numbers large enough to make his investment worth while, then, and not until then, will it be possible for women to purchase corrective shoes in every shoe store.

Many men and women have become educated to the need for, and the value of, corrective shoes. Upon investigation it will be found that every city, except the very small towns and villages, has shoe dealers who carry in stock, or can order with little delay, corrective shoes. The demands of those men and women who realize what benefits and comforts are possible with corrective shoes have already caused shoe dealers to assist in supplying the demand for corrective shoes. In all of the larger cities (fifty thousand population and over) full lines of corrective shoes are on the shoe dealers' shelves.

A satisfactory shoe is one which permits free foot function and preserves the normal foot contour. Some of the necessary factors in a correct shoe are as follows:

1. There should be no pressure on any one part of the foot.
2. There should be no looseness which may allow friction.
3. The soles should be sufficiently thick to protect the foot from injury and moisture. The soles should be flat. (Many shoes are of the rocker type and hinder plantar flexion.)
4. The inner border should be straight.
5. The heel should be broad, medium low, and of rubber surfacing.

6. The heel counter should fit the heel snugly. A combination last will give this feature, as it prevents inward rotation of the calcaneus.

7. The shank should be narrow, but wide enough to fit the foot and snug enough to support the inner side of the arch in passive standing.

8. The toe cap should be full enough to allow free action of the toes. This necessitates greater thickness (or height) in the region of the large toe and less height over the smaller toes. When the weight is on the foot, there should be a space of one-half inch from the end of the longest toe to the end of the toe cap. This is necessary to provide for toe room after the foot has become warm. Without this allowance a shoe, which was thought to be long enough when the shoe was first fitted, will prove to be too short after the shoe has been used in walking.

9. The shoe should lace together over the upper part (dorsum) of the foot.

10. The shoe should be of good leather, neat, and not too heavy.

What Type of "Corrective" Shoe Shall I Wear? The question is often asked, "What particular type of corrective shoe should a person wear?" The answer is, "It depends upon the particular type of foot for which the shoe is intended." If the shoe fulfills the ten conditions listed above, the shoe is correct. It makes no difference what the trade name of the shoe may be. Too many people think that because a shoe has a name which sounds "corrective," it will answer their needs. The name is not always a guarantee that the shoe is a correct shoe for every individual.

To offer a list of possible shoes from which one might choose correct foot gear necessitates the personal equation factor of the author. A book, *Foot Knowledge*, by the late Dr. Herman W. Marshall (published by the *Boot and Shoe Recorder,* Boston, Mass.), contains Dr. Marshall's ideas based on his personal experience in wearing various corrective shoes. Dr. Marshall was a heavy man, weighing about two hundred pounds and his experiences would not necessarily be the experiences of men of one hundred and fifty pounds. Dr. Marshall, however, experimented with the following shoes—a list which does not contain, by any means, the names of all corrective shoes.

Anatomik—Field and Flint Co., Brockton, Mass.

Arch Preserver—E. T. Wright and Co., Inc., Rockland, Mass.

Educator—Rice and Hutchins, Inc., Boston, Mass.

Everest and Supple Tread-types. (Made on Last 62)—Lewis Crossett Co., No. Abington, Mass.

Glove Grip—M. N. Arnold Co., No. Abington, Mass.

Ground Gripper—Ground Gripper Shoe Co., East Lynn, Mass.

Trupedic—Churchill and Alden Co., Brockton, Mass.

Sorosis. (The A. E. Little shoe)—A. E. Little Co., Lynn, Mass.
Hilgert Inner Mold—Emerson Shoe Co., Rockland, Mass.

The name of the shoe is not the important factor to be considered in fitting the foot correctly. The writer's personal experience, in his work with the students of Illinois and business men and women, has developed a reticence against the policy of clinging to any one type of corrective shoe and claiming it as the panacea for all foot ills. The differences of feet require differences of shoes. A foot which is weak needs one kind of shoe; a foot which is flat needs an entirely different type of shoe.

In cases of weak or deformed feet an orthopædic surgeon's advice should be sought before purchasing corrective shoes. Owing to the many different types and styles of corrective shoes on the market to-day there should be no difficulty in securing the right "corrective" shoe. Corrective shoes are something like glasses. Glasses can be secured from mail order houses who require only the knowledge of the person's age; or they can be secured from an oculist who requires a thorough examination. They are "glasses" in either case. Corrective shoes can be secured from a shoe salesman who requires only a trade name; or they can be secured according to the prescription of an orthopædic surgeon who requires a careful examination of the feet. They may be "corrective" shoes in either case but only in the latter case are they the *right* "corrective" shoes for the individual.

Flexible or Stiff Shank? Another common question is, "Shall I wear a flexible or a stiff shank?" A definite answer to this question cannot be given without examination of the foot. A stiff shank is useful in cases where rest and support are needed. It must be understood, however, that the shank must properly fit the arch. In cases where long periods of passive standing must be endured, the stiff shank, properly fitted, will support the foot. For elderly people whose muscles are not supple, and for overweight individuals, the stiff shank gives greater ease and foot comfort than the flexible shank.

Some authorities feel that the stiff shank, if properly fitted, is best for every one. This belief is open to debate. The wise use of one or the other at the proper time is best. Stiff shanks protect the feet but do not strengthen the foot muscles. Flexible shanks allow the foot muscles to function. To place a flexible shank on a falling arch is like trying to "tame a wild horse by giving it more rein." In cases of painful, weak feet the best type is the stiff shank which is worn for a period long enough to permit rest of the strained muscles. But after the painful stage has passed and better muscle tone has been established by corrective exercises, the gradual use of the flexible shank is recommended. If a person has good muscle tone, the flexible shank may assist in better foot function and consequent increased development of proper muscle balance and foot strength. With a heel that is broad

and extends well forward under the arch, more nearly normal arch action and plantar flexion can be secured with flexible shanks. However, the type of foot must be considered before deciding whether a flexible or a stiff shank should be used.

Height of the Heels. The height of the heels which one should wear is not thoroughly understood by many individuals. The height of the heels can best be determined by the degree of possible dorsal flexion of the foot. With the foot bare and resting on the ground the foot is at right angles with the leg. In the average foot a dorsal flexion of from ten to twenty degrees is expected. With a one-inch heel the foot is in ten degrees plantar flexion. The calf muscles take up this slack of slightly less than one-half inch. With a two-inch heel the foot is in twenty degrees plantar flexion. The calf muscles have now taken up a slack of almost one inch (*i.e.*, the tendon Achilles is almost one inch shorter than normal). Thus, allowing a maximum of twenty degrees dorsal flexion in the normal foot, the foot with the shortened tendon Achilles can be drawn up to only a right angle.

The "stylish" dress shoe of the modern woman shows a heel of more than two inches. "Style" is measured by the height of the heel. This means that the calf muscles have taken up so much slack that, even with maximum dorsal flexion of twenty degrees, the foot can not be drawn up to a right angle. The modern woman's deformity is seen when she removes her shoes and attempts to walk—or hobble. She walks on her toes, or tries to walk with the foot flat on the ground by stretching the shortened tendon Achilles (a difficult feat), or she turns her feet out (abduction and eversion) to relieve the tension on the tendon Achilles.

With a very high heel (two inches or higher) the woman is walking on stilts. The entire body is out of alignment. Her gait is stiff, and her knees must sag to allow a lowering of the leg bones. Faulty mechanics cause her feet to tire after only a very slight amount of walking. Often her lower back feels pain. Added to this discomfort, the weight of her body rests on the forepart or spring portion of the foot. She finds herself unable to plantar flex the forepart of the foot. Pain is felt under the depressed metatarsal bones. Metatarsalgia is one of the natural results of wearing high-heeled shoes. The muscles from the back of her head to her heels are constantly overworked in an attempt to maintain a semblance of body balance.

After much suffering many women attempt to go back to a low heel. This attempt is beset with many obstacles. Rather than gradually decreasing the height of the heel, she makes a sudden change from a two-inch heel to a one-inch heel. This causes a readjustment of body balance which is fatiguing and often painful. The shortened heel cord is now overstretched and becomes irritated by the lowering of the body. Feeling that the cure is worse than

the deformity, many women decide to suffer less and wear high-heel shoes. They decide that the discomfort of the high heels is much less than the torture of the low heels. But the change from the high to the more sensible low heel may be accomplished if two rules are observed:

a. It must be done gradually.

b. The heel of the new shoe, being slightly lower than the old shoe, must be carried forward to relieve the strain on the arch. In the low-heel shoe the arch is used more than in the high-heel shoe. Thus when a one-inch heel is finally worn with comfort, care must be exercised to provide for a slight elongation on the inner front of the heel to support the arch.

Children's Shoes. As many of the foot deformities of adults have their beginning in ill-fitting shoes in childhood, it behooves the parent of to-day to avoid the common error of fitting the child with a pair of new shoes without first making certain that the shoes are the right type, correct shape and proper fit for the child's foot. It is too much to expect the child to know whether or not the shoe fits correctly. The thrill of having a new pair of shoes makes many youngsters say that the shoe feels all right when in reality it does not. Also the child does not complain when the foot has outgrown the shoe, but he shows subjective symptoms of fatigue. He does not care to run around with the other children, and he desires to sit when the other children are having a good time playing games.

The following requisites should be noted in fitting children's shoes:

1. The shoe shape must conform to the shape of the child's foot.
2. The foot must be comfortable within the shoe. This can be determined by having the child bear his entire weight on one foot while the parent feels whether the shoe wrinkles or is too tight, whether the shoe is long enough, etc.
3. When the weight is on the foot, a space of three-quarters of an inch should be allowed between the end of the longest toe and the end of the toe of the shoe. This can be determined by pressing the finger on the end of the toe cap. (The space of three-quarters of an inch will allow for natural elongation when the foot is used and for rapid growth of the child's foot.)
4. The leather should be durable but not too stiff.
5. The heels should be low and broad, but the heel counter should fit very snugly the calcaneus bone area. The heel of the average child's shoe is faulty in this respect.
6. The shank should be flexible. For foot development there must be foot function. The only exception is in cases of actual foot deformity where a stiff shank must be used. In these cases proper alignment is necessary and a stiff-shank corrective shoe is needed as an initial procedure to proper walking and foot exercises.

7. Care must be exercised that, as the child grows, his feet do not outgrow the shoes. Too many children's feet are injured when their rapid growth pushes them against the forepart of the toe of the shoe until they finally cease to function efficiently. It is poor economy to make a child wear a shoe which does not fit him, simply because the shoe is not worn out. This seventh requisite is the one most frequently ignored.

Stockings should be considered as favorable or unfavorable factors in foot action. (This applies to adults as well as to children.) Short, tight stockings bind the foot and restrict normal foot action. Loose stockings, which wrinkle and cause abrasions, tend toward a shifting of the body weight to avoid the irritation of the abrasion. This throws the foot mechanism out of balance and often starts foot strain.

B. Contributory Causes of Weak Feet

1. *Injuries to the Lower Leg and Foot.* Foot strain and weak feet following severe injury to the lower leg are common in athletics and in industry. Immobilization of fractures for too long a period and subsequent muscular atrophy leave a foot weak and liable to strain. Following the removal of casts from the lower leg, care should be exercised to provide the foot with ample opportunity for normal development and at the same time to protect the foot from strain. The use of a shoe of the Munson last (army shoe) type is more favorable to normal foot function than the use of a carpet or hospital slipper. The various physiotherapeutic modalities should be used in order that good tone may be developed in the foot and leg.

2. *Overweight* is a serious factor in weak and flat foot conditions. A person who puts on weight too quickly often presents a weakened muscular system. This results in a disproportion between the weight which must be borne and the strength of the supporting structure—the feet. Weak, strained and often flat feet result from this condition.

3. *A debilitating illness*, which leaves the body weak, presents a problem quite akin to the above. In cases of general muscular weakness the weight of the body is too great for the weakened supporting structure, and foot strain and flat feet result.

4. *Rickets.* A history of rickets is found in many cases of weak and flat feet.

C. Symptoms of Weak Feet

1. *The Outstanding Symptom of Weak or Strained Feet Is the Ever Present Attitude of Abduction or Eversion.* The muscles and ligaments on the inside of the foot and ankle have been overstretched until the abductor muscles are the stronger of the two groups. The Achilles tendon is usually

shortened. This shortening can be demonstrated by having the patient attempt to do a full squat while his heels remain on the floor and his feet are kept parallel. He will usually squat with his heels off the floor and his feet turned out.

2. *A Feeling of Weakness* is noted in the majority of weak and strained feet. The body as a whole is weak, but the feet are especially lacking in tone. There is a general feeling of discomfort and unwillingness to use the feet in standing and walking. This discomfort may extend to the legs and even to the lower back. The posture is generally a "fatigue posture" or slouch. The individual generally accommodates his habits to his feet.

3. *Pain* is present only in proportion to the amount of work to which the feet have been subjected. After a day's rest there is no pain. But muscular spasm in the peroneal muscles and tenderness in the tibial muscles are often the aftermath of any unusual foot activity. Pain may be felt from calluses where undue weight has been imposed on one area of the foot.

4. The victim is often *unable to secure a comfortable pair of new shoes.* The old shoes have conformed somewhat to the shape of the feet—or in many cases the feet have conformed to the shape of the shoes. It is therefore difficult to find a new shoe that feels right.

D. Examination of the Feet

A review of the classification of foot conditions and the causes and symptoms of weak feet will give one a good idea of what to look for in the foot examination. Many foot examinations are of a clinical nature. If the arch is flat, the foot is classified as a third-degree flat foot. If the normal contour of the arch is present, the foot is graded as normal. In many cases the third-degree flat foot, being symptomless, gives no pain, while the normal appearing foot gives its owner a great deal of trouble and pain. An examination must do more than diagnose whether a foot is flat or normal in clinical appearance.

A high arch does not necessarily indicate a strong foot. The height of the arch does not accurately measure the strength or usefulness of the foot. Many flat but symptomless and strong feet may be noted, as well as weak contracted feet with unusually high arches. Talipes cavus or hollow foot shows an extremely high arch and is properly classified as a foot deformity. (See Figure 46.) The high arch is very likely to break down under a slight strain which would not seriously affect the low arch. A normal foot may present a low, medium or high arch. The wearing of short, tight or high-heeled shoes will often cause a high arch which is not only very painful but also becomes a very poor aid in locomotion.

The examiner must consider the foot as an organ of support of body weight and as a propulsion force in locomotion. In other words, the exami-

nation must be a "*functional*" examination. Feet differ in different individuals, due to various influencing factors such as vigorous outdoor life on one hand and sedentary living on the other. The functional examination should not be concerned with the superficial differences but should consider the defects and deformities of the feet in the light of interference with normal foot function.

Various devices may be used to examine the feet. The fluoroscope will show the arrangement (or derangement) of the bones of the feet. This

FIGURE 46

Talipes cavus

(Showing very high arch. A deformed foot)

is valuable, but not entirely practical for all examinations. The foot impressions are of interest but of little practical value because:

1. Too much emphasis is given to the height of the arch as an indication of the strength of the foot.

2. The non-weight-bearing impression is *followed* by the weight-bearing impression, thus producing a composite picture of weight and non-weight bearing.

Dr. Lovett comments on foot impressions as follows: "In imprint tracings the non-weight-bearing tracing is indelibly recorded before weight-bearing position is reached." He gives as his method of determining the weight-bearing position as follows: "The patient stands on a piece of plate glass, under which, and facing the light, is a mirror set at an angle of forty-five degrees to the floor. In this mirror may be seen with great clearness the reflection of the bottom of the feet, bearing weight. The weight-bearing

surfaces appear as dead-white areas, while the lines of contact can be seen easily."[1]

An army procedure of examination which can be used to handle a large number in a short space of time is as follows: An incline twenty feet long leads to a platform four feet square and about three feet six inches from the ground. Seated facing the platform and the incline are two doctors. The men to be examined walk up the incline and come to a halt on the platform. The doctors note, during the men's ascent of the incline, the use of the feet. As the man reaches the platform, further examination is made as to the musculature, pain, range of motion, etc. A quick classification based on foot function is possible by this means.

For ordinary groups the best method is individual examination of each student. It is well for the student to stand on a sturdy table during his examination to save the examiner from the fatigue of constant stooping over. The student should be stripped, at least from the knees down. The points of observation are as follows:

1. Read a complete history of the case, previously taken, to ascertain the general condition of the student.

2. Note the passive attitude in standing. (It is well to have observed this prior to the time when the student thinks the examination has begun.) The passive attitude gives the examiner an idea of the foot position which, no doubt, is assumed most of the time when the individual is standing. A perpendicular dropped from the anterior-superior spine of the ilium should bisect the center of the patella and should also bisect a line drawn through the heel and the second toe. Note deviations.

3. Note the general body posture, tone of muscles, excessive sweating of the feet (hyperidrosis), fetid sweating (bromidrosis), cramped toes and shortened dorsum tendons.

4. Palpate the tubercle of the scaphoid for tenderness. Do the same at the base of the metatarsals.

5. Look for calluses. Corns and calluses denote faulty weight-bearing or undue friction.

6. Test flexibility of the feet. Adduction is limited in cases where the astragalus has slipped on the calcaneus bone. Limited dorsal flexion will be found in muscle-bound feet. Have the student walk to observe his gait. Test for normal foot function.

7. Note inward rotation of the legs.

8. Note contour of the arches.

9. Compare the prominence of each malleolus on each ankle.

[1] Jones, Sir Robert, and Lovett, R. W., *Orthopædic Surgery*, p. 603, Wm. Wood and Co.

10. Observe the feet from the rear. Note tilting inward of heel and bowing inward of Achilles tendon.

11. Question student as to history of pain in, or adjacent to, feet.

12. Observe shoes for fit, bulging at arch, style, manner in which heels and soles are worn down.

An ideal time to impress upon the student the importance of good function is during the individual examination. Each point of importance should be explained to the student while his interest is centered in the procedure of examination. Too many times the examinations are mere cut-and-dried preparations for more statistics. Rather than more statistics there should be more instruction, more prevention, more correction, etc., if the number of deformed and weak feet are to become less.

E. Treatment of Weak Feet

No blanket prescription for the treatment of weak feet can be offered to meet the requirements of the varied types. There is too much difference in feet and in individuals. Certain principles of treatment can be offered, however, with the firm understanding that these *principles* are to be used only as they fit the individual case. The principles of treatment of weak feet are as follows:

1. Education.
2. Rest.
3. Removal of the cause.
4. Restoration of structural balance by artificial supports.
5. Corrective exercises.

1. *Educational Principles.* It is not enough that the individual be told HOW he should walk and what kind of shoes he should wear. The actual carrying out of the prescription is the important factor in the treatment of weak feet. Habits must be changed and this changing requires constant repetition of the new act until it finally becomes automatic.

The coöperation of the individual must be secured. It is necessary in the case of younger people to show them the immediate benefits which will be secured by walking properly. For the older person an explanation of the real facts of his condition is advised. Normal foot movements should be explained to him. The fact that the correct foot position is the most stable and insures muscular efficiency with the least amount of effort generally interests the older student and the adult. His muscular deficiency and its relation to foot fatigue and general body fatigue must be emphasized. The relief which comes from throwing the weight to the outer sides of the parallel feet will often answer his question of why he fatigues too readily when standing.

The majority of those with foot difficulties really desire relief—but in the quickest and easiest possible manner. It must be understood that a condition which is the result of years of abuse is not correctable by a few minutes of exercise. It will take months to correct the foot condition and more months of correct walking and proper shoe wearing to render the correction permanent.

Failure to understand that correction takes time has led to the increasing use of arch supports. The gullible public are told by the high-pressure shoe salesman that his particular arch support (a palliative measure at best) will cure the customer's foot trouble. The relief which is experienced by many wearers of arch supports is often mistaken for a cure. They do not understand that an artificial aid is doing the work which ordinarily is done by muscles and ligaments. These same muscles and ligaments are now weak and overstretched and the wearer of the arch support fails to realize that further lack of function leads to further weakness of these unused parts. The arch support allows these muscles and ligaments to become weaker and weaker. This fact is discovered by some individuals, who have been wearing arch supports for some time, when they attempt to walk without their arch supports. The task, if at all possible, is very painful.

2. *Rest.* When muscles and ligaments have been strained and the feet and body fatigued, there is great need for rest to relieve the muscle spasm which accompanies this strain and fatigue. Results are not satisfactory in cases where the individual is allowed to use his feet while the muscles are spastic and painful; generally an aggravation of the condition results. The rest procedure in painful cases is as follows:

a. If the pain and spasm are severe, complete rest in the form of a plaster paris boot should be applied.

b. Or, as an alternate to the above, the individual may be put to bed for three or four days and not allowed to bear his weight on the feet during this time. Hot applications are useful during this time for the relief of pain and spasm. Non-weight-bearing exercises also help to prepare the part for weight-bearing. These exercises can usually be given after a day of rest in bed and are followed by contrast baths to tone the parts involved.

c. As a third choice, suitable, well-fitting arch supports or adhesive dressings should be applied, and the individual should be cautioned against anything but absolutely necessary activity.

d. Hot and cold (contrast baths) may be used in connection with any of the above procedures to relieve pain and spasm.

3. *Removal of the Cause.* This principle must necessarily overlap the various other principles in the treatment of weak feet. It should be given special attention if satisfactory results are to be secured. When incorrect

use of the foot has been the main cause of the difficulty, it is obviously pointless to give the various physiotherapeutic treatments unless the cause of the incorrect foot condition is removed. The cause may be ignorance of what correct foot use is. It may be that the individual's shoes make it impossible for the feet to function correctly. Some well-meaning teachers conduct foot classes with the students in gymnasium shoes and never see the shoes which the students wear for twelve or more hours. The shoes which a student wears daily should be examined and advice given in cases where incorrect shoes are worn.

Complete cure is not possible, even in weak foot cases, until the cause of the difficulty is removed and normal foot function is made possible. It is obvious that cases of weak and strained feet following injury cannot be handled on the basis of removing the cause of the foot strain, but the faulty foot gear and the faulty gait can be remedied. In obese cases the superimposed burden of excess body weight is at least a contributing cause of the foot weakness. Weight reduction is necessary in these cases. Rickets cause weak and flat feet in children and these cases must be handled from the medical side largely. Until the rachitic condition is relieved, there is little hope of securing correction for the effects of rickets.

4. *Restoration of Structural Balance by Artificial Supports.*

a. Restoration of muscle balance is gained by the use of the "Thomas heel." In order that the proper mechanical use of the feet may be made possible the Thomas heel, fitted to a satisfactory shoe, is a very effective measure. The Thomas heel is constructed by wedging up the inner side of the heel. The wedge or lift is raised one-eighth to one-fourth inch on the inside of the heel and tapers down to zero at the outer side of the heel. This wedge may be extended forward on the inner side, under the arch, for a distance of one-half to one inch. (Figure 47.)

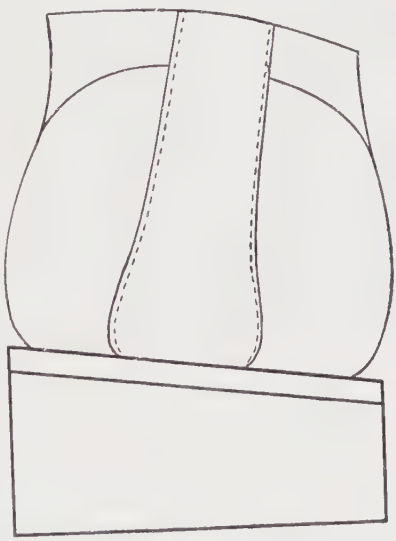

FIGURE 47
"Thomas heel"

With a well-fitting heel counter, the effect of the Thomas heel is that of raising the inside of the calcaneus and thus throwing the weight of the body more on the outer border of the foot than on the inner border. If the heel counter is too wide, however, the entire heel of the foot is thrown

against the outer portion of the heel counter and the ankle is allowed to roll inward, thus aggravating the condition rather than correcting it. (Figure 48.)

b. Adhesive Strapping. (A temporary support.) In cases where absolute rest is out of the question and in cases where a few days of diminished activity has allayed the spastic and painful condition, adhesive strapping is a satisfactory temporary support. This strapping assists in maintaining correct foot position and correct muscle balance. The foot is strapped to secure inversion, adduction and dorsal flexion of the foot. The method of application is as follows:

FIGURE 48

Showing the possibility of a poor heel position due to wide heel counters

The hairs are shaved from the lower half of the leg. The patient sits with the foot drawn toward the front of the body. Adhesive plaster one inch wide is cut into six strips, three of which are sixteen inches long and three are ten inches long. A small felt pad, one-quarter of an inch thick and beveled to fit under the arch of the foot, is placed in position. The first long strip is applied slightly back of the external malleolus. It passes under the heel, covers the rear edge of the felt pad and is drawn tightly up the inside of the ankle and fastened on the outer side of the leg. The first short strip is applied from the middle portion of the inside of the foot, parallel with the sole of the foot, and is drawn around the heel to be fastened near the base of the small toe. The second long strip overlaps the first long one, and the second short strip overlaps the first short one until the basket weave is complete. A cotton bandage is used to cover the adhesive and thus cause better contact of the adhesive to the skin. (Figure 49.)

c. Arch Supports. The indiscriminate selling of ill-fitting arch supports cannot be condemned too severely. The average "stock" arch support causes additional foot weakness and increases the existing position of abduction of the forepart of the foot. The shoe salesman is not the logical source for an arch support prescription. The orthopædic surgeon who has made a careful examination of the individual's foot is the logical one to prescribe arch supports when they are needed.

The false idea behind the use of arch supports in cases of weak and

painful feet is that the "bones must be pushed *up* into place." This idea has grown out of the erroneous notion that the height of the arch is an indication of the strength of the foot. Weak feet need more than mere lifting up; they present a problem of faulty weight-bearing, incorrect muscle balance, and weakened muscles and ligaments. To restrict further the use of the weakened muscles by an ill-fitting arch support is to increase the muscular weakness. The important factors in the recovery of strength of the foot are the restoration of correct weight-bearing, muscle balance, and muscular and ligament tone.

FIGURE 49
An adhesive support

Properly fitted arch supports are necessary in certain cases of weak and strained feet; they are advised as a means of resting the feet. The proper type of arch support is one which supports the calcaneus bone, as well as the arch of the foot. A light sheet metal support which fulfills the above requirements and prevents lateral strain is commonly used. This is bent to a right angle, with one part under the heel and *gripping* the outer border of the calcaneus bone while the other portion extends upward along the inner side of the foot toward the astragalo-scaphoid joint. (Figure 50.)

This support is worn temporarily until the painful condition has subsided. The use of the arch support is not unlike the use of a splint for a broken bone. After a certain time the splint must be removed or there will result a weakening of the structures by interference with normal muscular action and circulation throughout the part. Thus the arch support, fitted properly, is used temporarily in certain cases of painful and weak feet. If it is to be used for any length of time, suitable exercises must be used to prevent weakening of muscles and ligaments of the supported parts.

Arch supports are recommended for more permanent use to elderly people who lack muscle tone and who must be on their feet a great deal of the day. They are also useful in cases when one cannot command the aid of the patient or when voluntary effort is not sufficient to prevent further weakness and deformity. A child will often be benefited by some form of support for weak, strained, or flexible flat feet.

This support need not necessarily be a steel support. The Thomas heel is used with very good results on children's shoes. Another aid for children's

feet is a small rubber sponge cut in half with the straight side resting against the inner side of the shoe. This, when pasted in the shoe by a thin strip of leather, maintains a good arch contour and keeps the weight on the outer (cuboid) portion of the foot.

It is especially urged that the use of arch supports, in cases of weak, strained and flexible flat feet, be supplemented with other therapeutic meas-

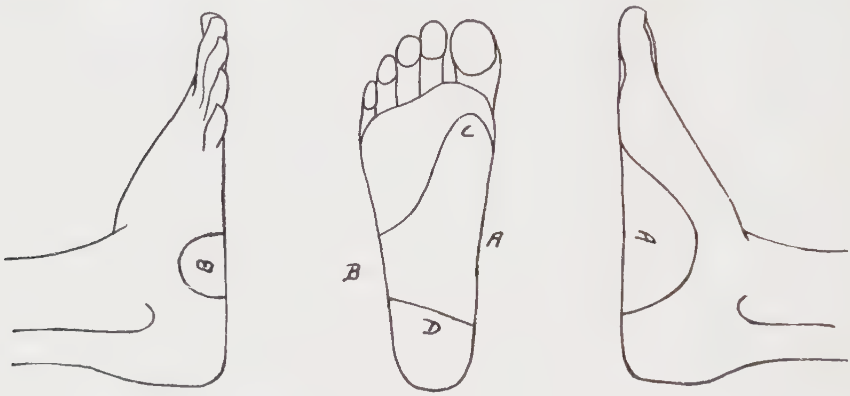

FIGURE 50
"Whitman" arch support

ures. Electricity (sinusoidal, etc.), massage, contrast baths and exercise used in conjunction with arch supports, will develop strength in the corrected position and lead to more lasting correction than that secured by the use of arch supports alone.

VI. CORRECTIVE EXERCISES FOR WEAK FEET

Exercises are contraindicated in spastic, painful or inflamed weak feet. After the pain has subsided, non-weight-bearing exercises may be given first and then weight-bearing movements to develop better muscle tone and normal foot function.

In the majority of cases of weak feet, the condition has been developing for a long time. A proportionate length of time must be allowed for developing habits of normal foot function and for strengthening the feet in the corrected position. Immediate relief, often secured by suitable shoes and a pair of Thomas heels, does not constitute a cure of the existing foot condition. The long-continued use of exercises, proper shoe, and correct standing and walking are necessary for a lasting relief. This caution may seem overcautious. In actual practice, however, people are prone to take a few exercises

and wear correct shoes for a few weeks and, feeling much better, think that their feet are entirely well and need no further care or attention. The relief of some of the symptoms of weak feet may occur in a short time. But the lasting results—the restoration of the tone of the part, and the formation of the habit of using the feet correctly—require many months.

The actual prescription of exercises must be preceded by an investigation of the habits and occupations of the individual. For the individual who takes his exercises at home and can rest in bed for an hour after exercising, a more vigorous workout can be prescribed for the feet and body. The student who, after finishing his exercises and shower, must go to a distant class, needs exercises which will benefit his condition without causing too much fatigue. A student who hobbles around on his fatigued feet generally aggravates his condition.

Exercises which result in a feeling of fatigue often discourage a student. During the first few visits to the gymnasium the student should be given light exercises in the sitting or lying position. After his feet are more accustomed to the exercises, the first half of the lesson can be devoted to more strenuous corrective exercises for the feet, and the last half of the lesson (including the games) can be executed in a non-weight-bearing position. General hygienic exercises must be included in every foot lesson. The body as a whole must be considered, and these general exercises can be given with the body in good posture. The correct foot position must be maintained throughout the exercise period. It is the policy in all corrective classes to caution the student that this correct foot position must be maintained when he leaves the gymnasium as well as while he is in the gymnasium.

The following is a list of a few practical foot exercises:

a. *Fundamental Non-weight-bearing Passive Exercise.*

1. Position: Student sits on a chair. Instructor grasps the ankle of the student with the left hand, the foot with the right.

Action: Instructor slowly moves the foot in

(1) Plantar flexion.

(2) Inversion.

(3) Dorsal flexion.

Remarks: The movement is carried as far as possible without causing pain.

b. *Fundamental Non-weight-bearing Resistive Exercises.*

2. Position: Same as in No. 1.

Action: Same as in No. 1 except that the student resists the movements.

3. Position: Student sits on chair. The outer side of his right ankle is resting on his left knee.

Action: Right foot is adducted against the resistance of his own or the instructor's hand.

c. *Fundamental Non-weight-bearing Active Exercises.*

4. Position: Student sits on chair or stool. Both legs are straight, and the heels rest lightly on the floor. The feet are slightly adducted.

Action: (1) With the knees straight, the feet are plantar flexed and the soles inverted until they almost face each other. (2) The feet are now dorsi-flexed and an attempt is made to keep the soles inverted.

Remarks: The knees must be straight throughout the exercise.

5. Position: Same as No. 3.

Action: Same as No. 1 except that the student performs by his own power and volition the three movements of plantar flexion, inversion and dorsal flexion.

6. Position: Student sits on chair or stool. The feet are flat on the floor and parallel. The knees are bent at a right angle.

Action: "Ground Gripping" movement as follows: The student plantar flexes the toes of both feet, keeping the heels in the original position and attempting to raise as high as possible the arches of the feet.

Remarks: The tibialis anticus (outer side of the front of shin bone) will respond strongly in this movement. The student should be told of the advisability of his performing this valuable exercise whenever possible.

7. Position: Same as No. 6.

Action: (1) The student places a marble six inches to the outside of the toes of the left foot. (2) He reaches over with the right foot and picks up the marble with the toes of the right foot. (3) Keeping the right foot to the left of the body, he slowly raises the right foot to the outside of the left knee where the marble is placed in the waiting left hand. (4) He repeats, using left foot to pick up the marble from the outside of the right foot.

Remarks: The foot which remains on the ground must be kept in the correct foot position. This exercise is especially good for metatarsalgia.

8. Position: Student lies on back on floor. The legs are flexed at right angles to the floor.

Action: The instructor tosses a tennis ball which the student catches with the soles of his feet. The catch is made by a slight bending of the knees and inversion of the feet.

9. Position: Student lies on back on floor, hands under head.

Action: (1) He raises the right leg, with knee straight and foot inverted and dorsi-flexed, to a position at right angles with the body. He exhales. (2) He lowers leg to floor, pauses and inhales. He repeats with the other leg.

Remarks: Progression can be given by keeping both heels about a foot off the floor and alternately raising and lowering legs.

10. Position: Student sits on floor, arms folded on chest.

Action: He alternately flexes and extends knees, keeping both feet in a position of adduction, inversion, and dorsal flexion.

11. Position: Student is astride an ordinary bicycle which is prepared as follows: rear wheel is raised by jacking up at hub, pedal rests are removed, and the pedal bars are used in their places.

Action: Flexing the toes in plantar flexion, student executes the ordinary pedaling movement.

Remarks: Progression can be given by tightening the chain. This is a vigorous exercise for metatarsalgia.

12. Position: Student lies on back.

Action: (1) He alternately dorsi and plantar flexes the feet as the heels are slowly drawn toward the buttocks. (The toes are held in plantar flexion throughout this part of the movement.) (2) Using toes as fulcrum (feet slightly toed in) he pushes the heels toward the toes. (3) He keeps heels in position and extends toes forward. (4) He repeats action No. 2 of pushing heels toward toes. He continues actions No. 2 and No. 3 alternately until the legs are fully extended. (5) He repeats entire movement.

Remarks: The exercise becomes difficult as the knees are fully flexed. In extending the legs the exercise becomes even more difficult as the extension reaches completion. When the legs are almost straight it is impossible to touch the toes to the floor and keep the feet in good position. At this point the student is urged to "grip with the toes and push the heels toward the toes."

d. *Fundamental Weight-bearing Exercises.*

13. Position: Correct standing position, except with feet four inches apart.

Action: Roll the weight of the body to the outer borders of the feet, plantar flex the toes, and hold for thirty seconds. Relax to a normal weight-bearing position, and repeat.

14. Position: Same as No. 13.

Action: Keeping the knees straight throughout the movement, rotate the thighs and the lower legs outward, and plantar flex the great toes.

Remarks: Emphasize to the student the necessity of feeling the tibial muscles: "Lift you by your boot straps."

15. Position: Correct standing position.

Action: Walk with the body in good position and the feet inverted and adducted.

Remarks: The walk will be stilted at first. Emphasize the necessity of

getting "spring" into the walk. Progression is then made by giving the correct "heel and toe" walk.

16. Position: Same as No. 15.

Action: Grip step. Grip with the toes as the forefoot meets the floor.

Remarks: This is called "Ground gripping walk." A toe and heel exercise or goose step can be used as a preliminary to this exercise.

17. Position: Same as No. 16 except that the feet are ten inches apart. The forepart of the right foot adducted and resting on the nearest end of a towel.

Action: With vigorous plantar flexions and adductions of the right foot, the towel is drawn toward the left foot. Repeat with the left foot (drawing towel toward right foot).

Remarks: The heel is the pivot for the active foot. The knee is held straight, and the knee-cap must not turn inward. All the movement is done at and below the ankle. Progression can be made by placing a weight on the further edge of the towel.

18. Position: Correct standing position, except that hands rest lightly on the back of a chair (or against the wall).

Action: Keeping the weight on the heels, dorsi-flex the feet.

19. Position: Standing on the right foot, which is in the correct weight-bearing position. The left foot rests, at the base of the metatarsal bones, on the rung of a chair.

Action: Plantar flex the left foot, curling the toes downward around the rung of the chair.

Remarks: Progression can be given by (1) having the student move the chair forward and backward while the toes grasp the rung, (2) by bending the knee (one-half squat) of the supporting leg while the other foot is grasping the chair rung.

20. Position: Correct standing position, except with slight exaggeration on adducted position of the feet.

Action: Execute a full squat (*very slowly*), and keep heels on floor.

Remarks: The knees are spread, and the adducted position of the fore-part of the feet is maintained as the squat is executed.

21. Position: In front of ladder.

Action: Climb ladder. Weight of body is borne on the balls of the feet. The feet are turned slightly inward (adduction).

Any number of additional foot exercises can be devised by using ordinary calisthenic movements and adding correct foot positions. A device of Dr. C. L. Lowman's (devised primarily for body balance exercises) may be used to assist in stretching the peroneals and in tightening (taking up slack) the inner leg and foot muscles. The device is as follows:

Position: Student is astride a ten- to fifteen-degree angle ridge or double

incline tread which resembles an inverted V (Λ) Calisthenic exercises, not involving foot movements, are done while the students are astride this apparatus.

The feet should be bare while corrective foot exercises are taken. If he insists on a good foot position, the teacher is able to see just what foot action and foot development the individual possesses. In many classes rest periods are used as a preliminary measure before exercising. The feet are elevated to overcome the sluggish circulation in the legs and feet. When it is possible, the exercises should be followed by a rest in the sitting or lying position. A contrast bath should be taken to relieve fatigue and to tone the parts involved.

Although it is impossible to prescribe a list of exercises for all cases of weak feet without first knowing the condition of each case, a sample set often used with beginners is offered as follows:

1. A light postural exercise in the lying position.
2. A light hygienic exercise in the standing position. (Foot exercise No. 13.)
3. Picking up marble. (Foot exercise No. 7.)
4. Dorsi and plantar flexion and creeping. (Foot exercise No. 12.)
5. Correct walking. (Foot exercise No. 15.)
6. Abdominal exercise. (Foot exercise No. 9.)
7. Towel exercise. (Foot exercise No. 17.)
8. Breathing exercise in the lying position.

The game element must be introduced in foot exercises, for example:

1. Various circle games. These may be played in the sitting position (Feet are kept in the correct position.)
2. Relays. A marble is used as the baton. The marble is held under the toes. A dumbbell may be propelled along the floor by the aid of the ball of the foot. (Foot is plantar flexed.)
3. Catching tennis ball with the feet. (Foot exercise No. 8.) A light medicine or volley ball may be used in place of the tennis ball.
4. Picking up marbles with the toes. Marbles are placed in a receptacle which rests on a low stool. This stunt may be done against time or in competition with another student.

VII. PREVENTION OF WEAK FEET

It is unfortunate that the average individual delays seeking relief for foot weakness until the condition has become firmly established. Even then many individuals go through the gamut of "home remedies," advice of well-meaning friends and bizarre methods of quacks who promise unwarranted success. Only after all these have failed does the individual visit his doctor.

The longer the foot has been neglected the more difficult is the task of correcting the condition. Physical educators should watch for the first symptoms of weak feet. Any student who stands with his feet turned out (eversion), or walks with his feet turned out, should be cautioned against these habits. Obstacles to normal foot movement and development should be counteracted; advice on proper footwear should be given to all students. Vigorous follow-up work should be done to see that all these instructions are faithfully carried out.

Special emphasis must be placed on the prevention of foot deformities in gymnasium work and in athletics. The ordinary gymnasium slipper, tennis shoe, basketball shoe, etc., may be quite satisfactory for those whose feet are in good condition, but are not for those with foot faults. An exercise shoe should be one which fits the foot comfortably, supports the foot during rest and permits as much plantar toe and forefoot action as possible. Many old-style basketball and tennis shoes were of the rocker type sole which prevented normal plantar foot flexion. The latest type of correctly fitting basketball shoe has a lift on the inner side of the heel. The sole is flat enough to allow reasonably good plantar flexion of the foot.

The common complaint against the doctrine of correct footwear in athletics is that this type of "correct" shoe cannot be worn while the individual is indulging in athletics. Compare this condition to that of a weak, strained hand. The average intelligent individual is very careful to avoid further injury to his strained *hand*. He will often avoid shaking hands with his right hand if that is the one injured. Why will he not give a weak *foot* the same protection? Yet even though the feet are asked to do quantities of work each day, this same caution is not exercised in their behalf when they are strained and weakened. Of course the poor condition of some feet is due to poor body tone which comes from general disuse of the body, and in these cases the feet *may* become better developed through exercise such as basketball, track, etc. But it would be much better, then, to start with lighter body exercises before the strenuous games are undertaken.

It is true that the activity of fast running demands the parallel foot position. In so far as the exercise is concerned, it may furnish some development of normal foot position. The danger comes *after* a basketball game or track meet is finished. The individual is then somewhat fatigued, and his habitual stance being poor, he fatigues his feet by the strain of faulty balance and faulty weight-bearing. Thus the fatigue of the game is aggravated by the fatigue of the faulty foot position in standing and walking. The individual's feet are therefore worse off than if he had not played basketball or engaged in track events.

In many cases of weak feet, the added use of the feet in athletics, such as landing on hard gymnasium floors or pounding on a cinder track in long

runs, will be done while the fatigued feet are held in poor position. Thus added strain to the feet will result. It is urged, therefore, as a preventive measure, that weak and strained feet be rested from vigorous athletic work until corrective measures have been applied to restore normal muscle tone and balance throughout the injured parts.

Further warning should be given against the common habit of the average youngster of going out for athletics without first considering whether or not his foot and leg muscles are in condition for the heavy work which athletics demand. This must not be interpreted as decrying against the whole athletic program. It simply means a recognition of the fact that athletic and gymnasium work is relatively more severe than ordinary activity. The above statement is made after studying the results of freshman work in many sports of various high schools and universities. Many otherwise promising athletes are forced to discontinue their athletic career, for a time at least, in order that they may recuperate from foot ills. This inconvenience could be avoided in the majority of cases by considering athletics as an unusual strain and taking due steps to prepare the feet and legs for the athletic contests, as well as the other parts of the body and mind are prepared.

The freshman varsity basketball coach at Illinois became interested in the writer's criticism regarding the number of foot conditions which developed in his freshman basketball players. Upon investigation it was found that many of the freshman players had done very little physical exercise since the closing of their high school basketball season in March. In many instances there had been five to seven months of inactivity for their "basketball muscles." Their feet and legs were soft. Their knees would not hold up under the vigorous stopping, starting, jarring and pivoting which were necessary to gain the coach's recognition of them as future basketball timber. The natural results, in a large number of cases, were foot, leg, knee or hip injuries.

The writer, with the aid of this freshman basketball coach, analyzed the various "most used" vigorous basketball maneuvers and proceeded to develop a rudimentary exercise program, which had for its objective the development of the fundamental muscles most used in basketball and the consequent prevention of the common basketball injuries. Before any actual basketball practice was started, two weeks were devoted to conditioning work. Adduction of the foot against resistance (Foot Exercise No. 3) found the adductor muscles very weak when the work was first begun. The plantar and dorsal flexors of the foot and leg were developed. Squatting exercises were freely used, and the performance of the full squat with both heels remaining on the floor was especially insisted upon. At the end of two weeks, regular basketball practice was started. The results of this preventive work were shown in a marked falling-off in the number of strained feet and sprained

knees. The most used muscles had been toned up and put in a condition more favorable to developing better neuromuscular coördinations.

Preventive exercises have been recognized as a valuable factor in basketball training. Coaches are urged to add this preventive work to their pre-season training program. The number of good men who are disabled because of weak feet and strained muscles can be decreased seventy-five per cent. in one season of basketball if suitable preventive methods are used. Many parents who disapprove of basketball because of the danger of injury to their boys may be won over to the cause when they can be shown that proper preventive measures are taken to guard the boys against injuries. Much of the grief which often precedes an important game because a valuable player is out due to foot or knee strain can be prevented by pre-season preventive work.

Track men are frequent patients in the corrective department. The chief difficulty with this group is metatarsalgia. Their feet are often weak at the beginning of the training season, and their stride while training throws a great deal of work on the forepart of the foot. After the evening's drill is over, they assume a faulty foot posture (feet everted), and further fatigue their feet. Exercises which will tone the muscles most used in track should be given *before* actual track work begins. The plantar flexors of the toes should be unusually strong to provide a strong gripping action as the great toe pushes against the track before the leg is swung forward for the next step. The dorsal flexors of the foot should be well developed. The weakness of these muscles in track men is shown in the number of "shin splints" after the first evening's practice on the hurdles.

Another form of preventive work, which is often neglected in athletics, is the proper shoeing of the athlete. This is especially true in high schools where "finances will not permit" the school to supply the best foot gear for its athletes. Athletics, at best, is more severe than the ordinary activities of everyday life. Falls and bumps which would ordinarily call forth very strenuous objections are endured without whimpering—as "part of the game." The schoolboy who wouldn't think of walking a mile cheerfully runs over hill and dale in cross-country work. Athletics, being more strenuous than everyday activities, must be considered as an "unaccustomed avocation," and suitable provision must be made so that this unaccustomed activity will not find the body wanting. The body part which gives way under strain perhaps most frequently is the foot.

For the protection of the foot a figure eight bandage should be worn to prevent unguarded strain. At the beginning of the season this bandage can be used to prevent injury to the arch and ankle and still allow sufficient movement to develop the muscles in the proper positions for most effective foot function. A weak ankle giving way throws a strain on the knee so

quickly that the knee is injured before the muscles and ligaments can be brought into action to protect it.

In athletics and in regular classroom work, the student who gives a history of past or present pain or who habitually everts his feet should be treated as a potential weak foot case. Suitable exercises should be given him to prevent the development of a weak, strained or flat foot.

The feet of parents and adults in general are poor examples of proper foot position and foot function. The child sees too many poor examples of foot function at home and on the street. Parents, for their own comfort and for the future comfort of the child, should train themselves to walk and stand correctly. Classroom teachers should be urged to co-operate in stressing the parallel foot position during recitations. Younger children should be appealed to through "Indian games," etc., which call for elasticity in foot movement and parallel foot positions.

FIGURE 51

Training the baby
(Parallel foot position [sixteen months of age])

The chief difficulty encountered in working with individuals who are having foot troubles is that these conditions are of long standing. Many extend back to early childhood. It is for this reason that greater care is urged in early childhood. Every child with faulty body mechanics should be given exercises, and medication where necessary, which will tend to correct faulty body mechanics. Since foot position is a part of body mechanics, due emphasis should be placed on the proper gait during early childhood. A child can be taught to walk properly as easily as he can be allowed to develop improper walking habits. (Figure 51.)

The child's shoes should fit him when they are bought, and they should be discarded when his foot is no longer able to perform free movement within them. It should be the duty of every parent to inspect the child's feet and shoes at least once each month. Detecting departures from the normal at their inception makes correction of these abnormalities a matter of slight effort. Parents must understand that undue strain, such as faulty foot position, in one group of muscles will weaken the strained group, while the opposing muscles will shorten and thus throw the mechanism out of balance. This lack of balance results in general, as well as local, fatigue.

For the boy who is interested in athletics, but not interested in his feet, it is well to stress the necessity of strong durable feet in athletics. It is also well to explain to the boy that with his feet parallel he can cover more distance in the same number of steps than with his feet everted. The average everted gait requires six steps for what the parallel gait accomplishes in five—not to mention the lessened fatigue of the latter correct position.

VIII. FLAT FEET

The discussion of weak feet has been purposely confined, as far as possible, to the foot which, though mechanically weak, does not present the clinical evidences of any appreciable lowering of the arch. The rigid flat foot is amenable to cure only by methods outside the field of physical education. The flexible flat foot is seen very often in the gymnasium. This foot differs from the weak foot only in the greater intensity and duration of the conditions which cause foot weakness. The flexible flat foot has finally succumbed to the overpowering causes of foot weakness. The weak foot is still making a struggle.

The treatment of the flexible flat foot cannot be fully given by the physical educator. To exercise a deformity is to increase the deformity. Before a foot is developed to normalcy, it must be in a favorable position for normal foot movement. Flexible flat feet must first be made to conform to the normal foot contour. This is the work of the orthopædic surgeon. After the surgeon has prescribed arch supports or he has corrected the deformity by surgery, the foot may be given exercises and other physiotherapeutic treatments such as massage, contrast baths, electricity, etc. The exercises for flexible flat foot conditions are the same as the exercises which were recommended for the weak foot.

The treatment for flexible flat feet must be continued over a longer period of time than that for weak feet. The average flexible flat foot case will need a year or more of corrective exercises. During this time well-fitting arch supports are often used to retain the contour of a normal arch. The corrective exercises aim to strengthen the muscles in the corrected positions, tone up the body in general, restore balance throughout the muscles and ligaments of the feet and educate the individual in correct foot function.

The child with a flexible flat foot should be taken to the family physician for a careful medical examination. All possible foci of infection should be removed. Undernourishment should be overcome. Proper medication should be given and matters of rest and support for the sunken arch should be considered. *After* all these factors have been taken care of, the exercises should be commenced.

The notion is prevalent in the minds of many parents that a child will

"outgrow" a deformity such as flat feet, poor posture, etc. For the one child who has outgrown his deformity there are ninety-nine who have not; and many of these ninety-nine show an increased degree of deformity. Childhood is the period for correction. Parents are slowly awakening to this fact—but their awakening is altogether too dilatory. The "Summer Round-up," which emphasizes the necessity of an examination and the correction of the defects and diseased conditions before a child enters school, is a step in the right direction. More emphasis is needed on the prevention of defects and the correction of existing defects *early* in the life of the child.

IX. MISCELLANEOUS DISTURBANCES OF THE FEET

A. Metatarsalgia (Morton's Toe, Painful Calluses on the Ball of the Foot).

A painful condition in the anterior arch of the foot arises from an overstretching of the ligaments which normally bind the heads of the metatarsal bones. The longitudinal arch is often affected as well as the anterior arch. "Morton's toe" is distinctly a neuritis caused by pressure on the plantar nerve by the head of the fourth metatarsal bone. The term "metatarsalgia" is used to denote the composite condition of the overstretched ligaments and the neuritis which is caused by the pressure of the metatarsal head, or heads, on the plantar nerve, or nerves.

1. *Symptoms.* The characteristic symptoms are:

a. Burning pain in the region of the heads of the metatarsal bones. The pain is usually most intense under the fourth metatarsal head. The pain is relieved by rest, and aggravated by walking.

b. Flattening of the anterior portion of the top of the foot, directly back of the toes. In many cases the tendons on the dorsum of the foot will be very prominent.

c. Calluses on the ball of the foot in the region of the second, third and fourth metatarsal heads.

2. *Causes.*

a. The high heels which many women wear. (Metatarsalgia is most frequent in women by a ratio of almost three to one.) High heels tend to shorten the Achilles tendon and throw the weight of the body on the heads of the metatarsal bones. The anterior arch is flattened by this abuse. The anterior arch should be patent at all times, except near the end of the step when the weight is temporarily on the ball of the foot prior to the final push-off of the toes.

b. Short shoes. Short shoes cramp the toes and interfere with the

normal function of the forepart of the foot. When the function is impaired, the strength of the part is depleted, and the anterior arch gives way.

c. Sitting with the knees at less than a right angle and the weight of the leg resting on the anterior arch. (Figure 52.)

FIGURE 52

A common sitting position which depresses the heads of the metatarsal bones

d. Track work (running) in cases where the feet are not strong enough to bear up under the pounding which the balls of the feet must endure.

e. Rounded lasts or "rocker shoes." The last on this type of shoe is curled up at the outer edges of the entire sole. This makes the insole concave, rather than straight or slightly convex against the foot. Many cheaper shoes, after becoming wet, show this curling-up of the soles. Many athletic shoes have curled-up soles. These are partially due to the fault of the shoe and partially to the fault of the owner. A damp shoe which is thrown into a locker rarely keeps its shape, for it usually lands in a position which increases the rocker shape of the sole. As the shoe dries, it retains the rocker shape. Since such vigorous action is demanded of the forepart of the foot in athletic work, caution should be exercised to avoid shoes which restrict this necessary forefoot action. (Figure 53.)

f. The habitual position of eversion of the feet. This faulty position causes disuse of the forepart of the foot which in turn causes a weakness and sinking of the anterior arch.

g. Infantile paralysis. Following infantile paralysis a hollow foot develops in many cases. The ball of the foot and the heel are the only parts of the foot which bear weight and an unusual strain is thrown on the anterior arch.

3. *Treatment.*

a. Remove the cause, as far as this is possible.

b. Relieve the mechanical pressure on the plantar nerves. The following means may be used:

(1) A flat-soled shoe which grips the arch of the foot and keeps the metatarsal bones from spreading. This shoe must, at the same time, allow free action throughout the entire forefoot.

(2) A felt pad (two and one-half inches long, one inch wide and one-quarter of an inch thick at the center) placed just back of the heads of the metatarsal bones and firmly secured with a two-inch adhesive strap. The

adhesive keeps the pad in place and prevents the bones from spreading. (Strap encircles the forepart of the foot except for a one-inch gap on the upper surface of the foot.) A snugly fitting elastic bandage with a rubber pad inserted back of the heads of the metatarsals is also very effective.

(3) A thin insole to which is secured a piece of felt as in procedure (2).

(4) a bar of leather one-quarter to three-eighths inch thick and one inch wide, applied to the outside of the sole of the shoe from the inside edge back of the first metatarsal head to the outside edge back of the fifth metatarsal bones. (Figure 54.)

(5) A leather insole, extending to the middle of the long axis of the metatarsal bones and beveled at the distal end, with rubber inserts to press up against the middle of the metatarsal bones.

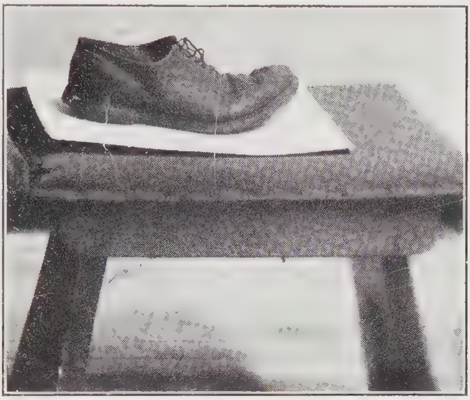

FIGURE 53
"Rocker" shoe

c. Restore normal foot function and development by exercises. The ideal type of exercise is the one in which the toes are plantar flexed and the foot adducted. The towel exercise, picking up marbles, grasping the rung of the chair, climbing a ladder while bearing the weight of the body back of the metatarsal heads are the ideal type of exercises for metatarsalgia. As in

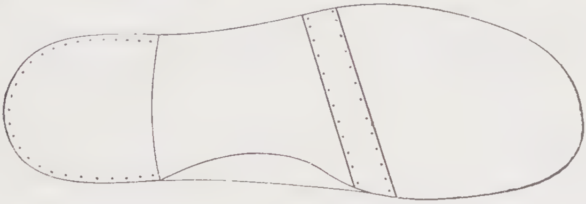

FIGURE 54
Tarsal strip—for relief of metatarsalgia

the treatment of other local conditions, general exercises for organic vigor and skeletal tone must be emphasized.

B. Hallux Valgus

Often but not necessarily accompanying cases of metatarsalgia is a condition where the great toe is deflected outward (away from the center

of the body). This condition is one affecting the first metatarso-phalangeal joint.

1. *Symptoms.* The symptoms are types of anatomical deformity in various degrees. The great toe does not fall on Meyer's line. In many cases it is turned toward the center of the foot until it underlaps or overlaps the second toe. The head of the first metatarsal bone points away from the center of the foot, and the great toe points toward the center of the foot. The angle thus formed often becomes irritated by the pressure of the shoe, and a painful bunion may be present.

2. *Causes.* The chief cause is a short shoe or one which is too narrow at the toe. A short and narrow shoe crowds the toes together within the shoe. Tight stockings, too, often distort the foot even though the shoe may fit perfectly. The shortness of the shoe or the stocking causes a pressure backward against the great toe. This pressure is then transmitted to the first metatarsal bone which begins to point away from the ordinary straight forward position. The flexor longus hallucis muscle becomes shortened and displaced laterally. When the feet are everted, each step causes a further lateral displacement of the great toe.

3. *Treatment.* Corrective exercises are of little or no value in cases of severe hallux valgus. Operation for the removal of the head of the metatarsal bone and a lengthening of the extensor longus hallucis is resorted to in marked cases of hallux valgus. Following the operation care must be exercised in the wearing of correct shoes and in proper walking. If faulty footgear is worn and the feet are everted in walking, the joint may still be aggravated and a recurrence of the hallux valgus may result. Following a hallux valgus operation the foot is placed in a position most favorable to normal action of the great toe. After the cast has been removed, tone and proper foot function must be restored to the part. Exercises are useful in gaining these ends. The type of shoe worn following the operation can assist in the restoration of normal foot function. The Munson army last with its straight inner border and wide ball is the choice of footgear. A Thomas heel often assists in promoting the parallel gait in walking.

In milder cases of hallux valgus, footwear is important in treatment. The inner border of the shoe must be straight. A toe splint may be worn at night to assist in correcting the toe position. This splint is straight on the inner border of the foot; a strap secures it around the arch and another strap is used to draw the great toe against the splint.

Some authors recommend a tin or aluminum insert in the insole in the form of an upside down T. This is inserted through the insole and presses the great toe away from the second toe. In mild cases this stall effect may be satisfactory, but in anything but mild cases, the cure is worse than the

deformity. Wedges of rubber inserted between the great toe and the second toe are worn with greater ease but have no corrective value. The tendency is for the stronger great toe to press against the rubber and the rubber in turn against the weaker second toe.

A lift or tarsal strip placed on the sole of the shoe, back of the heads of the metatarsal bones (as in metatarsalgia), tends to stretch the extensor longus hallucis and relieve pressure from the head of the first metatarsal bone.

Exercises to restore normal action throughout the forepart of the foot are of indirect benefit to the milder cases of hallux valgus. The greatest service which corrective physical education can render to hallux valgus cases is to prevent the condition. This can be done, in the majority of cases, by correct shoes, correct walking and normal muscle balance.

C. Affection of the Achilles Tendon

1. *Irritation of the Bursa Lying Between the Tendon of Achilles and the Calcaneus.* A swelling is felt on the inner side of the point of insertion of the tendon. Pain is increased by contraction of the posterior calf muscles, and it is lessened by rest. This condition may be due to an injury, but it is often caused by some infectious systemic condition, such as arthritis, gonorrhea, etc.

The systemic cause must first be removed. The next procedure is to provide rest and immobilization for the affected part. A felt pad under the heel will eliminate some of the contraction activity of the posterior calf muscles. Adhesive strapping, extending from the middle of the sole of the foot up the posterior surface of the heel to the middle of the calf of the leg, will act as a restriction to motion and promote rest of the affected part. The various physiotherapeutic measures such as hydrotherapy, massage, etc., are needed to augment the circulatory efficiency and to tone the parts.

2. *Tenosynovitis of the Tendon Achilles.* Due to an injury or a strain of the tendon itself, an inflammatory condition, characterized by swelling and tenderness of the tendon, results. When the hand is placed on the tendon, a grating sound is heard as the foot is plantar or dorsi-flexed. The sudden change from high to low heels will produce, in many cases, this inflammation of the tendon. The treatment procedure is the same as in No. 1.

3. *Irritation of the Bursa Lying Between the Tendon and the Skin.* This is due to an injury. In many cases the wearing of high-cut shoes will cause this irritation, by causing pressure and irritation of the bursa. A combination of tenosynovitis and irritation of the posterior bursa is very common. As in the other conditions mentioned above, rest is the most important

element of the treatment. Contrast baths are very helpful in restoring tone in this condition.

4. *Ruptured Tendon Achilles.* A sudden lurch of the body often causes a definite tearing of the tendon Achilles. If the ankle is bound, as it often is, there is a failure of proper repair and the consequent loss of flexor action of the tendon. Also a form of connective tissue which is adventitious to that part will often result from the irritation caused by severe binding of the ankle. A ruptured tendon Achilles is best treated by the orthopædic surgeon.

5. *Bromidrosis* (fetid perspiration) is a discouraging foot condition found in many athletes. A foot bath in water in which a few crystals of potassium permanganate have been dissolved gives very good results. Clean white stockings should be used and changed daily. The use of hot water alone must be avoided. If the condition persists, a general medical examination should be insisted upon.

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CHAPTER VII

HEART DISTURBANCES

The fact that heart disease is the single cause of the largest number of deaths has stimulated the medical profession and other health agencies to a more intensive campaign against this new "Captain of Death." The latest government bulletin (Jan. 6, 1928) states that there were 209,370 reported deaths from heart disease in the United States during the year 1926. And it is estimated that for every death from heart disease there are ten individuals handicapped because of the disease.

It is significant to note that the removal of tuberculosis from its former conspicuous position as the greatest killer, was accomplished by the elevation of the general health of the masses. It was not accomplished by attacking the tuberculosis bacilli in the tissues of isolated cases. Though the need for destruction of the tuberculosis bacilli was stressed, a more intensive effort was directed toward the improvement of general conditions which were known to undermine health.

In work with heart cases a more complex problem confronts the medical profession. The bacillus which causes tuberculosis is known, but one or more of the various pathogenic bacteria may be the cause of heart disease. And yet both diseases are fought in the same way. The same principle of general elevation of health, through the improvement of conditions which are known to undermine health, is applicable in the campaign now being waged against heart disease.

The statement that physical education can be of some good in the campaign against heart disease is often greeted with severe criticism. This criticism arises from the misconception, in the minds of many, that physical education is athletics. Athletics is only a branch of physical education. When there is a thorough understanding of the difference between physical education and its athletic branch, there is a ready acceptance of physical education as an important modality in the campaign against heart disease. Physical exercise serves in two ways: it restores better organic function in certain cases of heart disease; and it increases the physical vigor and resistance to disease.

Generally speaking, the only types of heart cases which will be found in the gymnasium are the ambulatory cases with functional murmurs, and cases with slight organic murmurs with good compensation for moderate

exercise. Graduated physical exercise is valuable in both functional and organic heart cases for the purpose of increasing organic vigor and improving bodily functions. With the increase in organic vigor there is a consequent improvement in heart action, although the heart lesion still remains.

To secure a general elevation of health through the improvement of conditions which are known to undermine health, the use of physical exercise is necessary. It is one of the most valuable means of increasing physical vigor and resistance of an individual. Physical exercise which is within the individual's needs and capacity raises his health level by:

a. Promoting better organic function of the entire body.
b. Developing better neuromuscular control.
c. Improving the body mechanics.
d. Improving nerve innervations.
e. Increasing the respiratory efficiency.
f. Regulating the metabolism.
g. Improving the elimination.

The above factors in rasing the health level are useful in preventing heart disease and in relieving the heart of its excessive burden when the heart is not normal. One of the most valuable effects of exercise in cases of heart disturbances is the establishment, by exercise, of a better equilibrium in the filling and emptying of the heart. The amount of blood which the heart sends out with each beat is dependent upon the amount of blood in the heart at the end of its rest period (diastole). The squeezing action of the muscles upon the veins and smaller arteries augments the flow of blood to the heart, thus supplementing the pumping action of the heart and supplying it with more blood upon which to work. This means that there is more blood to be used by the coronary arteries in nourishing the heart itself. Exercise thus nourishes the heart. As the heart is a muscle, the use of this muscle preserves the integrity of the myocardial properties—excitability, conductivity, tonicity, contractility.

Exercise will NOT cure an organic heart lesion. However, by using carefully graduated exercises and attending duly to better health habits in general, exercise can and does improve the general condition of the body as a whole. In this way it is a preventive of heart disturbances in that it removes some of the conditions which often undermine health.

A. Causes of Heart Disease

The exact cause of heart disease is not universally agreed upon. It is said to be caused by some disintegrating force or forces which, by interfering with the integrity of the heart muscle properties create a disturbance in

equilibrium between the energy of the heart and the resistance in the peripheral body parts. The disintegrating force or forces which bring on the heart disturbance have not been fully agreed upon. There is a leaning, however, toward the acceptance of one or more of the various pathogenic bacteria as the disturbing factor. A number of general causes may be listed:

1. *Infection or Overexertion?*

The old idea that overexertion was the cause of heart disease and subsequent failure has been cast aside by many. Some make the sweeping claim that even strenuous and prolonged exercise does not injure the normal heart. They further insist that other systems, such as the muscular system, the respiratory system, and the nervous system, will succumb to fatigue before the normal heart has reached the limits of its marvelous reserve. But unfortunately there were 209,370 reported deaths from heart disease in the United States in 1926. The marvelous reserve must have failed in many cases.

Vacquez [1] treats the subject quite fairly when he concludes that heart failure can be reproduced perfectly by overexertion and that overexertion is capable of causing the myocardial changes noted after death. He adds, however, that some predisposing cause must first intervene to lessen the resistance of the heart. The subjects from which his conclusions are drawn presented past histories of poor nourishment, syphilis, alcohol addiction, etc.

Lewis says, "Infection has more to do with cardiac failure than strain or a mechanical defect in the heart itself." [2] Diseased tonsils, decayed teeth, and other infections may not affect the heart of an individual who avoids exposure and fatigue. But these infections in an individual who is poorly nourished or fatigued, or whose resistance is lowered from one cause or another, are possible causes of heart disturbances. "In supervised athletics the heart is developed and its reserve power increased with a slowing of the pulse rate and a more perfect adjustment of the cardio-vascular system." [3]

There seems to be a half-way point between the "overexertion" and "infection" theories as the cause of heart disturbances. The idea that a *normal* heart may be injured by exercise is seriously questioned by many doctors. There is sufficient proof in the studies made on athletes of the late nineteenth century to show that oarsmen who *have kept themselves in good condition after their athletic career* are not troubled with heart disturbances from their severe exertion and overexertion. There is not sufficient proof

[1] Vacquez, H., *Diseases of the Heart*, p. 584, Saunders Co., 1925.

[2] Lewis, T., *The Soldier's Heart and Effort Syndrome*, p. 37, Paul Hoeber Co., New York, 1910.

[3] Black, E. C., "Physical Education in Heart Cases," *Amn. Phy. Educ. Rev.*, 29:317, June, 1924.

to show that overexertion will affect a trained individual who possesses a strong heart and ample reserve. In fact the danger lies, not so much in the acceleration of the heart during severe exertion, but, in the sudden cessation of athletic work after college days are over.

Common sense is needed in interpreting the theories of infection *vs.* overexertion as the cause of heart disturbance. No doubt, infection is the predisposing cause. This does not mean, however, that the normal heart will remain "normal" in the face of continued overexertion, exposure, fatigue, and lowered resistance. From the writer's personal experience in and with athletics he would suggest the following solution. A man in perfect condition (absence of infection, strong heart, and ample reserve) will not suffer from heart disturbance following exertion or overexertion. The claim is not made, however, that this overexertion can be repeated again and again without damage, for overexertion causes a lowering of the resistance of the body. Unless care is given to the body following the overexertion, there may not be full recovery in the respiratory, muscular, and nervous systems; the vital organs may not recover sufficiently, and resistance will be lowered. At this point, in the body which has been allowed so little rest that the systemic resistance has been lowered, some pathogenic bacteria may force entrance, and a heart disturbance may be the result. Thus with a predisposing cause such as this pathogenic bacteria, the next overexertion may find the bodily resistance so low that the heart itself will be affected.

2. *Errors in Diet.*

The warning against errors in diet applies especially to the sedentary individual who eats rich foods in larger quantities than his system can handle. This practice causes a lowering of resistance throughout the various bodily organs and a pathogenic disturbance in the alimentary system which finally causes a heart disturbance. The overeating and underexercising habit of many adults must be considered as a cause of heart disturbances.

3. *Exposures.*

Due to the rapid loss of body heat and the extra work thrown upon the heart by the necessity of supplying this heat energy, exposure to intense cold causes a rapid lowering of resistance throughout the body. Thus the body may find itself unable to fight off successfully some of the pathogenic bacteria. Excessive heat likewise causes a severe exertion of the heat-regulating mechanism with resultant bodily fatigue and lowered resistance.

4. *Failure to Practice Daily Personal Hygiene Habits.*

Heart disease is a condition which does not result from errors in community hygiene. It is due in the majority of cases to carelessness of the individual himself. This carelessness may run from failure to keep the mouth clean to definite exposure to disease germs.

B. Types of Heart Disturbances

The question of the exact nature of the heart disturbance which a student might have is a problem for the physician. Physical educators should be directly concerned in knowing only whether the student is normal or abnormal, and if he is abnormal, the physician determines the abnormality and reports his diagnosis with whatever instructions and cautions he considers necessary. To aid in the interpretation of the physician's diagnosis, heart disturbances may be divided into:

1. Functional disturbances.
2. Organic disturbances.

1. *Functional Heart Disturbances.*

As a rule, a functional disorder is a mild affection. Care must be taken to prevent the heart insufficiency from affecting other parts of the body or developing into an organic lesion. The recommendation of the physician is an accurate guide as to the severity of the case and the possible outcome. Certain forms of abnormal rhythm are classed as functional heart disturbances. If they are accompanied by other signs of circulatory disorder or if they are produced with abnormal facility, these abnormal rhythms must be suspected of being signs of more serious import. Excessive smoking, indigestion, etc., often cause the rhythm to be disturbed. Exceptional disturbance of rhythm should not cause any worry, but persistent disturbance may react harmfully on the organism.

The rapidly growing adolescent whose heart has not kept pace in growth with the body often presents a functional murmur. But this murmur generally clears up in a few years or sooner, providing care is taken to prevent undue strain through athletics, exposure, etc. The adolescent should, as a preventive measure, be protected against undue strain in athletics. Long dashes in track work, tournaments in basketball, etc., cause a general body fatigue and lowered resistance which make it easier for the pathogenic bacteria to cause heart disturbance.

The sedentary life of many individuals causes a weakening of the heart muscle. Signs of cardiac distress are noted after exercise. Care should be taken by these weakened individuals lest too great a strain be suddenly thrown upon the organism. This sudden strain may be accompanied by a lowered bodily resistance, and thus provide fertile ground for the pathogenic bacteria.

2. *Organic Heart Disturbances.*

In an organic heart lesion there is a malformation of one or more of the valves. This condition is not amenable to cure by physical exercise, although in mild organic lesions the improvement in the general bodily tone and

organic vigor may be secured through graduated physical exercise. The more serious organic heart cases are not encountered in the gymnasium.

C. Symptoms of Heart Disturbances

Pre-clinical Symptoms. If the campaign to combat heart disease is to be successful, definite steps must be taken to offset the disturbance before the heart lesions have been firmly established. There is an erroneous idea, which many people have, that heart disease first manifests itself by pain in the region of the heart (precordial pain). At first heart disease rarely manifests itself by symptoms which call the average person's attention to the heart. Thus early diagnosing is as yet quite rare. Periodic health examinations will bring to light many cases of heart disturbances in their earliest stage, thus making possible the prevention of further disturbances in cases which otherwise are destined to become serious. The following are subjective symptoms which, if produced with abnormal facility, should demand further investigation as to the condition of the heart:

1. Shortness of breath on slight exertion (Orthopnœa). This condition is noted in compensated hearts.
2. Heart "hurry" or other disturbances in rhythm.
3. Discomfort or oppression in the chest.
4. Undue physical fatigue on slight exertion.
5. Poor recovery in pulse rate following exercise. A tardy return of pulse rate to the pre-exercise level is a good test for exercise tolerance. According to Barringer the capacity for physical exercise is undoubtedly a valid criterion of the condition of the heart's efficiency, because the capacity for exercise depends essentially on the heart's ability to increase its output, provided the lungs, the nervous system, and the skeletal muscles are functioning in a normal manner.[1]
6. Cyanotic lips, showing absence of oxygen. This also denotes blood stasis. Pallor, fainting or giddiness should be suspected of indicating vasomotor disturbance.
7. Difficult or labored breathing on exertion (Dyspnœa).
8. Small, rapid or weak pulse.
9. Yawning or gasping for breath on slight exertion.
10. Extra beat or intermittent pulse. These may be found in normal individuals although they are signs of abnormality.
11. Enlarged heart diameter in the transverse plane.
12. Heart sounds which were clear before exercise and are muffled following exercise.

[1] Barringer, T. B., "Exercise Tolerance in Heart Disease," *Jour. A.M.A.*, 79:2205-6, December 30, 1922.

13. Delayed rise or actual fall in the heart rate with exercise.
14. Anemia, thyroid enlargement, vasomotor insufficiency.
15. Discomfort on lying down or heart rate increased in this position.

According to MacKenzie, "It is the abnormal facility with which signs of exhaustion are produced, and not the signs themselves, which is the earliest indication of heart failure."[1] This should be kept in mind when one discovers any of the above fifteen abnormal signs. Lee reports that in over seventy per cent. of the Harvard students a cardiac murmur of considerable intensity, concerning the existence of which there would be no dispute among auditors, can be demonstrated under the appropriate conditions of breathing and posture. With forced expiration, without breathing, and in the recumbent position, a systolic murmur can usually be heard in the pulmonic area. Lee concludes that such findings suggest that the presence of a systolic murmur is compatible with a reasonable health standard.[2]

The fifteen symptoms listed above should be useful for detecting heart disturbances in the majority of schools. After a careful medical examination, a heart condition may suddenly manifest itself by a number of the symptoms noted. This does not mean that the examination was not thorough. It does mean that an examination is not an insurance that nothing can happen to the heart after the examination. This list of symptoms should also be found useful in observing students following debilitating illnesses.

D. Compensation

This term is one which is frequently used by the physical educator who handles subnormal individuals. The physician sends a report to the gymnasium with the information that a certain student has "Mitral Regurgitation, with good compensation." The following résumé from Osborne[3] should clear up any misunderstanding regarding the meaning of the term "compensation."

In mitral regurgitation the mitral valve does not close properly, and the blood leaks back from the left ventricle into the left auricle. Compensation occurs when the left auricle grows larger (hypertrophy), thus attempting to send so much blood into the left ventricle, that, in spite of the amount of blood which leaks back, sufficient blood will be sent out into the aorta and thence to the body parts. The muscular tissue of the auricle is not sufficient to allow any great hypertrophy. The blood flowing from the pulmonary veins into the left auricle finds this cavity already partly filled with blood which has regurgitated

[1] MacKenzie, Sir James, *Principles of Diagnosing and Treatment in Heart Affections,* Oxford Press.

[2] Lee, R. I., "Investigative Opportunities in the Physical Examination of Larger Groups of Individuals," *Journal of Industrial Hygiene,* p. 304, February, 1922.

[3] Osborne, O. T., *Disturbances of the Heart,* p. 124, Amn. Med. Association, Chicago, Illinois.

from the left ventricle. The pulmonary artery thus finds the pressure ahead unusually great, and the right ventricle reflexly learns that it requires a greater force to empty itself than before; in fact it may not succeed in completely accomplishing this until its distention, by an incomplete evacuation of its contained blood plus the blood coming from the right auricle, has caused the right ventriclealso to become hypertrophied. This increased muscular action of the right ventricle relieves the pulmonary congestion, and an increased amount of blood is forced into the left auricle. On account of this hypertrophy, the left auricle is able to send an increased quantity of blood into the left ventricle, which in turn becomes hypertrophied and sends enough blood into the aorta to satisfy the requirements of the systemic circulation in spite of the leakage of the mitral valve. Thus compensation has occurred.

But the fact that a heart has compensated does not mean that it is as good as a normal heart. It has cut down its reserve. The nutrition of the heart must be maintained, and no sudden strain must be thrown on the system. Strenuous exercise is forbidden, and the student must be moderate and free from tension in his activities. Regular and systematic graduated exercises will tone the entire system and the heart (through the coronary arteries) itself. Good exercise tolerance must be developed. This capacity for exercise is a valuable index of the heart's efficiency. With moderation and due care of health habits the individual with a compensated heart may outlive his neighbor who takes little or no care of his so-called normal body. It should be a cardinal rule, however, that those with compensated hearts visit their family physicians at least once each year to learn just what their condition really is.

E. Treatment of Heart Disturbances, by Exercise

1. *A bed-ridden patient* may be started with very light breathing exercises. Simple arm movements are used as progression. His strength is tested by having him flex and extend each knee alternately ten times. If no distress is manifested, the patient should be able to sit up and walk a few steps.

2. *Before resuming his former occupation* the patient who has been bed-ridden with a heart disturbance should spend a reasonable amount of time in building up his general body tone and organic vigor. The following is a prescription used in preparing a convalescent patient for daily activity.

a. On rising, rub the skin briskly with a wet towel wrung out in cool water.

b. Follow with a dry towel rub.

c. Rest in bed between blankets for five minutes.

d. Standing, execute breathing exercises. Inhale and exhale slowly five times, keeping abdomen flat and chest high (avoid strained breathing).

e. Rest for two minutes.

f. Do five more breathing exercises, as in "d," except raise arms to side shoulder level on inhalation and lower to sides on exhalation.

g. Rest two minutes.

h. Lying on back in bed, alternately flex and extend knees, assisting with hands. Exhale as the knee is drawn to chest (ten times).

i. Rest two minutes.

j. Dress slowly.

3. *Heart Cases in School Work.*

The exercise treatment which is given to the average heart case in the gymnasium presupposes a much better condition than that of the case mentioned above. Besides the functional disturbances, which need light exercises to tone the heart and the body, the majority of heart cases that are well enough to attend school will obtain lasting benefits from proper systematic exercises of a graduated nature. An injured limb must be rested at first, but after a time it must be used systematically to restore its functional powers. Heart cases (organic and functional) require the same treatment. In fact, it is not too much to say that restriction of all exercise in all but a few heart cases is positively harmful.

The dosage of exercise needs a certain amount of explanation. The average physical educator is prone to err on the side of giving too much exercise at first. The heart case is not a normal case and should not be treated as such. In connection with remedial work for heart cases, the term "protective exercises" is used. The ultimate aim is to improve the condition of the body. One of the immediate aims is to protect the individual from strain, and the principle is constantly borne in mind that muscular activity increases cardiac activity. An equilibrium must be established. Too marked an increase in cardiac activity is not desired. Therefore the exercise dosage is light at first. Simple light movements and sufficient rest between each exercise allows the effect of one exercise to quiet down before additional work is thrown on the system and on the heart. No tensing is given, and resistive exercises are not used because of the possible tensing which often results. Competitive games are forbidden because the danger of competition often arouses one to do more than his reserve allows. Golf, for its open air and, partly, individual nature, is recommended. Swimming is allowed only when the water is not too cold. Arm and leg exercises and light abdominal exercises are beneficial because they impart tone to the skeletal muscles and mildly stimulate the respiratory apparatus.

a. *Functional Murmur Case* (student poorly nourished—Figure 55) exercise program:

(1) Perform breathing exercise in supine position, with knees bent, feet flat on floor close to buttocks, and hands at sides.

(2) In same body position, with arms on floor at side shoulder level, raise arms toward ceiling and exhale. Lower arms to original position, inhale. Relax and repeat.

(3) In same position as number one, except legs are straight, draw right knee to chest, using both hands to assist. Exhale. Extend right foot to floor. Inhale. Relax. Repeat with left knee. (Alternate right and left knees.)

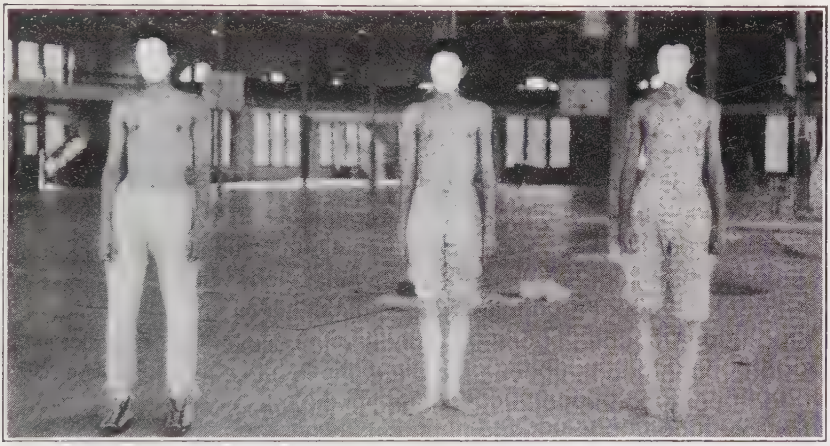

FIGURE 55
Functional heart cases

(4) Rest in good position on floor. (Knees bent, heels close to buttocks.)

(5) From the lying position, come to sitting position and rest for thirty seconds. Slowly stand and do the following: With feet apart and hands on hips SLOWLY twist *upper* part of trunk to right side, then front, then to left side. (Do not twist hips.)

(6) In correct standing position, slowly bend knees to a half squat, while flexing forearms on upper arms (elbows close to sides). Exhale. Slowly rise and extend arms to sides as knees straighten. Inhale, relax and repeat.

(7) Perform breathing exercise in the standing position.

(8) In correct standing position, except arms side shoulder level with palms up, slowly flex forearms on upper arms and exhale. Extend forearms to side shoulder level position and inhale. (Keep elbows at shoulder height, head up and abdomen flat throughout exercise.)

(9) Perform breathing exercise in the standing position.

(10) Practice correct "heel and toe" walk with head up, abdomen in, and chest held high. (This last type of exercise is given preceding dismissal because it prepares the student for his next activity, *i.e.*, walking out of class.) Theoretically the last exercise should be a supine rest exercise, but the dismissal bell or command generally causes the student to "fling caution to the wind" and jump to the erect position. This sudden change of position is dangerous.

b. *Functional Murmur Case with Good Body Tone.* (A much heavier group of exercises may be given to this type.)

(1) Assume the correct lying position. Practice correct breathing. (Chest held high and abdomen retracted.)

(2) Supine with legs straight and arms above head, on floor, in line with body, stretch right heel along floor and stretch right hand and arm, relax and exhale. Repeat with left arm and left leg. Repeat with right arm and left leg. Repeat with left arm and right leg.

(3) In same position as number two, draw both knees to chest and clasp with both hands. Exhale as knees are drawn to chest. Return to original position, inhale and relax. Progression is made by keeping heels twelve inches from floor as legs are extended. The exercise is done twice in this manner, and then the heels are placed on the floor and the student is allowed to rest. As exercise tolerance is increased, the exercise may be done four, eight or sixteen times before the definite rest period is given.

(4) Rest and breathe. As the student develops greater capacity for exercise this rest and breathing space may be occupied by the following exercise: Supine on floor, with knees bent and heels close to buttocks, arms side shoulder level on floor, stretch both arms toward ceiling and exhale. Return to original position and inhale. Supine exercises with the arms at side shoulder level are easily performed without strain because the reduction of resistance of blood flow through the axillary vessels causes less energy to be expended. This type of exercise is mildly stimulating to the heart.

(5) In standing position, with feet apart and hands on hips, bend trunk to right side, then front and exhale. Slowly swing trunk over left side and up to original position. Inhale, pause, and repeat, going to left side, then down, and up on right side. (See Figure 26, p. 135.) This exercise is done SLOWLY.

(6) Perform squatting exercise. (Same as number six in light functional heart series.) The squats are done very slowly.

(7) Perform breathing exercise, with light arm movements such as arms side up over head on inhalation and down to sides on exhalation.

(8) Perform the stationary jog. This is done by slowly raising alternate

knees to chest and gradually working into a slow, high knee action jog. Ten to twenty steps are done the first day, and pulse rate, return to normal, etc., are noted. As the exercise tolerance increases, this jog can be done for thirty seconds.

(9) Rest in the correct lying position.

(10) Stand with feet apart and hands over head. Bend right knee and touch outside of right foot with right hand. Left hand is pointing toward ceiling, above center of body. Return to original position and repeat on left side.

c. *Organic Heart Lesion, with Good Compensation.*

The exercise program for the organic heart lesion case, with good compensation, is the same as for the functional murmur case "a." (See page 216.)

After the organic heart lesion case shows improved exercise tolerance progression is made to the heavier exercises of "functional murmur case with good body tone." See "b," page 218.

Following the exercise program the heart cases should take a warm bath (94 degrees F.) for five minutes. This should be followed by a cool wet towel rub (80 degrees F.) and finished with a slow dry rub. A rest of from five to thirty minutes should follow the bath.

The three series of exercises given above are only suggestions for the various types of cases which come into the gymnasium. They are all subject to modification to meet the needs and capacity of the individual case. The exercises *per se* are not productive of good results unless the individual practices daily health habits, and avoids exposure and fatigue.

F. Special Pedagogy for Heart Cases

1. The average heart case resents, at first, his being placed in a corrective class. For that reason the term "protective exercises" should be used instead of "corrective."

2. The average case, the student who has been aware of his condition for some time, looks upon himself as an invalid. He lacks self-confidence. He has the defeatist attitude toward life. He must be shown that sane living and good health habits will still make a worthy citizen of him.

3. With the best of instruction the heart case is difficult to handle. He must be given suitable rest periods. These are often used, by him, for mischief and he must be convinced that his results are determined by his own efforts. If he idles away his time, he is wasting it. If this appeal does not cause him to change his attitude, he must be told that his actions are unfair to the other fellow who is really trying to better his condition. A man-to-man talk will generally bring out the good in the student.

4. The "joy of accomplishment" must be stressed in heart cases. They have been told that they must not do this, and they must not do that, until they are afraid that something is going to happen to their hearts if they exert themselves the least bit. They must, therefore, see clearly their daily improvement. For this purpose abdominal exercises (see 3, under case "b") of a fairly heavy type are given in the *supine* position. If these exercises were given without suitable rest periods, they might be too severe. As in the case of the abdominal exercise mentioned, both knees are drawn to the chest and the air is expelled as the knees are clasped with both hands. This position is not a strained one. As both legs are stretched out straight off the floor, they are held in this difficult position only for a fraction of a second and then they are drawn up to the knee bent position again. The caution is not explained to the student, but he is shown that *he can* perform fairly heavy abdominal exercises without any heart discomfort. In the same way the individual takes the prone leaning rest position and lowers his chest *upon* the floor and rests. He then pushes up to the prone leaning rest position and rests again in this position. But he is doing what he knows to be a difficult exercise.

5. Heavy exercises such as squats, abdominal movements, stationary running, etc., may be given in all but the more serious cases providing,

a. The student's exercise tolerance is good enough.

b. The exercises are done slowly.

G. Conclusion

The physical educator's efforts should be directed toward preventing heart cases by:

1. Giving systematic exercises of a hygienic nature. (Large muscles used in simple, well-known activities.)

2. Insisting upon a periodic health examination for all who come to him for exercise.

3. Preventing those under his charge from indulging in exercise which is unsuited to their needs and capacities.

4. Teaching "carry-over" games which will tend to prevent the sudden cessation of exercise and recreation which often results from our present athletic program.

5. Stressing the need of proper diet, rest, avoidance of fatigue, etc.

6. Carefully guarding those who have returned to the gymnasium following an illness of any length. (A medical examination would be the ideal thing in all of the recent illness cases.)

7. Carefully guarding the adolescent boy and girl in order that his or her resistance will not be lowered during this period of rapid growth. (This includes restriction from heavier athletics.)

One to two per cent. of the school children in the United States have heart disease. About two per cent. of the people of the United States have heart disease. Improvement in the conditions which undermine health will tend to raise the level of physical vigor and vitality. By the use of a health program which starts with a periodic health examination and includes daily health habits, there will be a marked reduction in the deaths from heart disease by those who avail themselves of this program.

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CHAPTER VIII

MALNUTRITION

Undernourishment and Obesity

I. UNDERNOURISHMENT

"Universal child health vanished from the earth long ago with the Paradise of Children. Baskets heaped with fruit—earthen pitchers brimming with milk, pot herbs and greens, oat cakes and honey—the sky for a thatch both day and night—and perfect health and happiness—all are universal possessions of childhood only in legends of the Golden Age.

"Centuries of walls and roofs and unnatural foods have made physical well-being for children a rarity rather than the commonplace that nature intended it to be. Yet the health of a nation's children measures the happiness and efficiency of its next generation of men and women." [1]

The above quotation is substantiated by figures in the Health Education Conference Report: Dr. W. P. Lucas of the University of California said, "Nineteen million out of our twenty-two million school children are defective physically, and of these, fifteen million are defective for preventable reasons." [2] T. Clark says, "One third of the school children suffer from malnutrition." [3] Cattle are tuberculin tested; cattle are given a balanced ration; pigs are sired by thoroughbreds; fishes are protected from stream pollution; and yet twenty to thirty-three per cent. of the school children in the United States are undernourished. Much is done for animals; relatively little is done for children.

A beginning has been made in the attempt to correct undernourishment in children. The United States Government, through its Departments of Labor, Interior, etc., has published a number of splendid bulletins and pamphlets

[1] Hallock, Grace T., *A School Program,* p. 2, Amn. Child Health Assn., New York, 1922.

[2] *Report of International Health Education Conference* (1923), Amn. Child Health Assn., New York.

[3] Clark, T., "A Plea for More Attention to the Nutrition of the School Child," *Public Health Report,* 39:2199, No. 35.

on child health and malnutrition.[1] The practical application of many of the principles contained in these publications is sporadic. A universal adherence to the principles is necessary. Physical educators must do their share in combating undernourishment. Physical examinations are needed to segregate those who are undernourished, and then a positive health program is necessary to correct definitely this condition.

There seems to be a general lack of adjustment to our changing civilization. Even "childbearing in this stage of our civilization is no longer necessarily a physiologic process."[2] Our lack of physical exercise and our "overstuffed" mode of living need to be counteracted by positive health programs. The present prevalence of malnutrition, if continued from generation to generation, will show in marked hereditary characteristics of the race.

A. Symptoms of Undernourishment

Malnutrition is the lay term generally used to classify those who are physically subnormal through underweight and undernourishment. Technically the term includes every fault of nutrition. While it is measured largely by height and weight in relation to age and physical development, there are many other signs which are used to determine undernourishment.

1. *Comparison between the well-nourished child and the one who is poorly nourished.*

The well-nourished child has an erect, sturdy, well-developed body with straight legs, flat shoulder blades, full rounded chest, flat abdomen, good teeth, odorless breath, firm, rosy, warm flesh, glossy hair, clean tongue, closed lips, good appetite, and an elastic gait. His eyes are bright and express a keen, happy mind. He shows an interest in things about him. He does not fatigue with ordinary play. His movements portray the spring and buoyancy of youth, without undue strain or nervousness. He is up to normal standard for his race, age and family characteristics.

The undernourished child is generally the opposite. His attitude is listless, he is nervous and appears as though burdened. His posture is likely to be poor. Poor circulation shows in cold hands and feet. His musculature is not good. His body is likely to show physical defects. (Diseased tonsils and enlarged adenoids are found in many undernourished children.) He is finical or fussy about his food. His school work is often erratic and below standard.

[1] *Health Education Publications,* Dept. of Interior, Bureau of Education, Washington, D. C., October, 1926.

[2] Rowland, J. M. H., "Reduction of Mortality and Morbidity in Childbirth," *Jour. A.M.A.,* 87:2158-9, December 25, 1926.

These signs are often divided into:

Physical signs of undernourishment	*Mental signs of undernourishment*
Lack of endurance	Lack of endurance
Mouth breathing	Restlessness
Flabby muscles	Finicalness
Physical defects	Contrariness
Poor body mechanics	Restless slumber
	Inattentiveness

Without attempting to discount the value of the "Height—Weight—Age Tables," we must consider a child's nutrition in more extensive terms than bulk and weight of body. The general balance and substance of the body, its mechanics, its physical tissues, its nervous system and other systems must all be definitely considered before classifying a child as in good nutrition or its opposite, malnutrition. We must not, therefore, make the mistake of thinking that height and weight indices are last and final in determining malnutrition.

One or more of the above symptoms being quite evident, further inquiry should be made as to the health of the child. A progressive rate of increase in weight and height are indications of good health in the child. But a child who is twenty per cent. above the average weight, height and age standard is considered to be in a condition of ill-health.

2. *Height-Weight-Age Tables.*[1] (Figures 56 and 57.)

Ten per cent. or more below the standard should classify an individual as undernourished. Deviation from the average weight for sex, age and height, plus evaluation of the physical and mental symptoms of malnutrition, should be jointly considered in determining undernourishment. Lithe children from lithe parents may be ten per cent. underweight and yet be perfectly healthy.

B. Causes of Undernourishment

1. *Defects* such as diseased tonsils, enlarged adenoids, decayed teeth, faulty body mechanics, etc. A child should be "free to gain." With one or more physical defects the undernourished child must expend a great amount of physical energy in merely combating these defects. Thus his resistance is low. Reserve energy is lacking. His physiological balance is disintegrated because the enormous amount of energy expended is greater than the energy produced.

[1] For weight table to be used for men and women, see Williams, J. F., *Personal Hygiene Applied* (2nd. Ed.), pp. 182-3, Saunders Co.

WEIGHT-HEIGHT-AGE TABLE FOR BOYS OF SCHOOL AGE

BY

DR. BIRD T. BALDWIN and DR. THOMAS D. WOOD

Ht. Ins.	5 yrs	6 yrs	7 yrs	8 yrs	9 yrs	10 yrs	11 yrs	12 yrs	13 yrs	14 yrs	15 yrs	16 yrs	17 yrs	18 yrs	19 yrs	Ht. Ins.
38	34	34*														38
39	35	35*														39
40	36	36*														40
41	38	38	38*													41
42	39	39	39*	39*												42
43	41	41	41*	41*												43
44	44	44	44	44*												44
45	46	46	46	46*	46*											45
46	47*	48	48	48	48*											46
47	49*	50	50	50	50*	50*										47
48		52	53	53	53	53*										48
49		55	55	55	55	55	55*									49
50		57*	58	58	58	58	58*	58*								50
51			61	61	61	61	61	61*								51
52			63	64	64	64	64	64	64*							52
53			66*	67	67	67	67	68	68*							53
54				70	70	70	70	71	71	72*						54
55				72*	72	73	73	74	74	74*						55
56				75*	76	77	77	77	78	78	80*					56
57					79*	80	81	81	82	83	83*					57
58					83*	84	84	85	85	86	87					58
59						87	88	89	89	90	90	90				59
60						91*	92	92	93	94	95	96				60
61							95	96	97	99	100	103	106*			61
62							100*	101	102	103	104	107	111	116*		62
63							105*	106	107	108	110	113	118	123	127*	63
64								109	111	113	115	117	121	126	130*	64
65								114*	117	118	120	122	127	131	134	65
66									119	122	125	128	132	136	139	66
67									124*	128	130	134	136	139	142	67
68										134	134	137	141	143	147	68
69										137	139	143	146	149	152	69
70										143	144	145	148	151	155	70
71										148*	150	151	152	154	159	71
72											153	155	156	158	163	72
73											157*	160	162	164	167	73
74											160*	164	168	170	171	74

Age—years		6	7	8	9	10	11	12	13	14	15	16	17	18	19
Av. Ht. (Ins.)	Short	43	45	47	49	51	53	54	56	58	60	62	64	65	65
	Med.	46	48	50	52	54	56	58	60	63	65	67	68	69	69
	Tall	49	51	53	55	57	59	61	64	67	70	72	72	73	73
Av. An. Gain (Lbs.)	Short	3	4	5	5	5	4	8	9	11	14	13	7	8	
	Med.	4	5	6	6	6	7	9	11	15	11	8	4	3	
	Tall	5	7	7	7	7	8	12	16	11	9	7	3	4	

Notes:

1. Age is taken at the nearest birthday; height at the nearest inch; and weight at the nearest pound. A boy is considered 6 years old at any time between 5½ and 6½ years.
2. The following percentage of net weight has been added for clothing (shoes, coats, and sweaters are not included):
   For weights from 35 to 63 lbs.—3.5% of net weight is added
   For weights 64 lbs. and over—4. % of net weight is added
3. The figures not starred represent exact averages in round numbers.
   The starred figures represent smoothed or interpolated values.

Printed by the Iowa Child Welfare Research Station, State University of Iowa, Iowa City, Iowa.

FIGURE 56

Weight-height-age table for boys of school age

WEIGHT-HEIGHT-AGE TABLE FOR GIRLS OF SCHOOL AGE

BY

DR. BIRD T. BALDWIN and DR. THOMAS D. WOOD

Ht. Ins.	5 yrs	6 yrs	7 yrs	8 yrs	9 yrs	10 yrs	11 yrs	12 yrs	13 yrs	14 yrs	15 yrs	16 yrs	17 yrs	18 yrs	Ht. Ins.
38	33	33													38
39	34	34													39
40	36	36	36*												40
41	37	37	37*												41
42	39	39	39												42
43	41	41	41	41*											43
44	42	42	42	42*											44
45	45	45	45	45	45*										45
46	47*	47	47	48	48*										46
47	49*	50	50	50	50	50*									47
48		52	52	52	52	53*	53*								48
49		54	54	55	55	56	56*								49
50		56*	56	57	58	59	61	62*							50
51			59	60	61	61	63	65							51
52			63*	64	64	64	65	67							52
53			66*	67	67	68	68	69	71*						53
54				69	70	70	71	71	73*						54
55				72*	74	74	74	75	77	78*					55
56					76	78	78	79	81	83*					56
57					80*	82	82	82	84	88	92*				57
58						84	86	86	88	93	96*	101*			58
59						87	90	90	92	96	100	103*	104*		59
60						91*	95	95	97	101	105	108	109	111*	60
61							99	100	101	105	108	112	113	116	61
62							104*	105	106	109	113	115	117	118	62
63								110	110	112	116	117	119	120	63
64								114*	115	117	119	120	122	123	64
65								118*	120	121	122	123	125	126	65
66									124	124	125	128	129	130	66
67									128*	130	131	133	133	135	67
68									131*	133	135	136	138	138	68
69										135*	137*	138*	140*	142*	69
70										136*	138*	140*	142*	144*	70
71										138*	140*	142*	144*	145*	71

Age—years		6	7	8	9	10	11	12	13	14	15	16	17	18
Av. Ht. (Ins.)	Short	43	45	47	49	50	52	54	57	59	60	61	61	61
	Med.	45	47	50	52	54	56	58	60	62	63	64	64	64
	Tall	47	50	53	55	57	59	62	64	66	66	67	67	67
Av. An. Gain (Lbs.)	Short	4	4	4	5	6	6	10	13	10	7	2	1	
	Med.	5	5	6	7	8	10	13	10	6	4	3	1	
	Tall	6	8	8	9	11	13	9	8	4	4	1	1	

Notes:

1. Age is taken at the nearest birthday; height at the nearest inch; and weight at the nearest pound. A girl is considered 6 years old at any time between 5½ and 6½ years.
2. The following percentage of net weight has been added for clothing (shoes and sweaters are not included):

   For weights from 35 to 65 lbs.—3. % of net weight is added
   For weights from 66 to 82 lbs.—2.5% of net weight is added
   For weights from 83 lbs. and over—2. % of net weight is added
3. The figures not starred represent exact averages in round numbers. The starred figures represent smoothed or interpolated values.

Printed by the Iowa Child Welfare Research Station, State University of Iowa, Iowa City, Iowa.

FIGURE 57

Weight-height-age table for girls of school age

2. *Lack of Parental Control.* Fully forty per cent. of undernourishment is due to this cause. Children are not only allowed to follow faulty health habits, but are actually given bad examples by parents. In many cases the child is born under poor conditions and subjected to harmful influences which continue throughout life. Thus environment is a vital factor in many cases of malnutrition. Moreover, very little is done in the way of periodic health examinations to determine the health of the child. Many parents who are thin feel that the child must naturally be thin. Heredity may be a cause of malnutrition in that the child has a poor start, but thinness as a family characteristic does not (statistically) bear heavily on undernourishment. Many children who have had a poor start in life (undernourished) but have received good care, later may become better nourished and stronger than the average child. As the child usually spends the first five or six years of life in the home, parents should use this period to correct existing malnutrition tendencies.

3. *Dietary Errors and Faulty Food Habits.* This does not mean that undernourishment is caused primarily because of lack of money with which to buy the proper types of food. (Not more than five per cent. is due to *poverty*.) There is more malnutrition in the socially and economically favored classes because:

a. Delicate children of the favored classes survive because of better medical care, and attention following birth.

b. Children indulge their appetites for fancy (though not nourishing) foods.

c. These children miss the physical development and organic vigor which come from hard work. Lifting heavy objects, swinging an ax, all kinds of farm work—these exercises combined with a satisfactory diet and good hygiene make for physical development. Even a lighter type of work combined with good food and good hygiene make for strength and poise of a degree which would be compatible with the needs of our present civilization.

But the children of the favored classes, as a rule, are rarely subjected to work which would produce adequate physical development and poise.

Improper food (butter substitute, refined table salt), rapid eating, irregular meals, insufficient breakfast, indulgence of individual dislikes for certain foods (coffee drunk in preference to milk, etc.), use of milk instead of water to quench the thirst, too long time between lunch and dinner (with candy-eating during this period), diet insufficient in kind of food and in amount (lack of vitamines and caloric value), etc., are a few of the specific dietary errors which cause undernourishment.

4. *Overfatigue.* The present-day child is living under a régime of rush, hurry, and high tension. Physical fatigue without adequate physical expression of the large muscles is universal. The home life is a mad whirl

of social engagements, late hours, and other health-undermining influences. The child is tired. His school work suffers. He loses sleep in his desire to "catch up" with his work. He becomes over fatigued. His resistance is lowered. He falls heir to many of the epidemics prevalent among school children. His weight is below normal for his height and age. He then shows the various subjective symptoms of undernourishment.

5. *Faulty Health Habits.* The simple laws of health are not obeyed. Mismanagement on the part of many parents is responsible for a high percentage of the cases of undernourishment. Besides faulty diet and insufficient sleep, the following errors in health habits must be mentioned:

a. Faulty elimination.
b. Insufficient relaxation.
c. Lack of wholesome exercise and recreation.
d. Insufficient liquid intake.
e. Failure to keep teeth clean and free from decay.
f. Ill-ventilated sleeping quarters.

C. Treatment of Undernourishment

To overcome malnutrition there must be a great deal of concerted effort on the part of:

1. The community.
2. The home.
3. The school.
4. The medical and physical education forces.
5. The child.

The community is placed first in the list of forces because of the absolute necessity for combined community coöperation in eradicating undernourishment. Due responsibility should be placed on the community. The home is the more specific force. The school must supplement where the home force fails. The medical and physical education forces are vital, positive health agencies. But all the forces above mentioned must necessarily be handicapped in their efforts unless the child is thoroughly "sold" on the necessity for his coöperation.

In addition to a clear understanding of the importance of the five forces mentioned above, the following specific activities are necessary to prevent potential undernourishment and relieve existing undernourishment.

D. Specific Principles in Treatment of Malnutrition

1. *A Careful Medical and Physical Examination of Each Child.* The various subjective symptoms of malnutrition must be considered as well as the classification by some accepted "Height-Weight-Age" table. The

complete examination must determine whether a condition of undernourishment exists, and also, as far as possible, what the cause or causes of the malnutrition are.

The necessity of the presence of the parents at the examination cannot be stressed too strongly. The possible hidden causes may be discovered by carefully questioning them. Also they will receive first-hand information on how malnutrition is caused and how their particular child should be treated. Some parents have the idea that one should "take care of the inches and the pounds will take care of themselves." They must be shown that as fast as the underweight child makes a gain in pounds, his height also increases. Thus to get a child started toward inches the mother must provide conditions favorable for increasing the weight. In other words, conditions must be favorable for normal growth.

2. *Preventive work* for those who are "borderline cases." This title includes the large number of individuals who are up to normal *standard* of height—weight—age, but who show one or more of the subjective symptoms of undernourishment; or those who are slightly (less than ten per cent.) below normal standard of height—weight—age, but who are free from the subjective symptoms of undernourishment.

A careful physical and medical examination will reveal these cases. Then existing physical defects should be corrected. The children should be guarded against overfatigue. They should be given sufficient rest periods throughout the day. An adequate program of physical education for this group should have, as its immediate aim, the developing of organic vigor and good body mechanics. Any faulty diet habits (and faulty health habits in general) should be corrected. The children should be shown the need for their personal coöperation.

3. *Removing the Cause.*

a. Bodily defects must be corrected. Diseased tissue should be removed. This applies especially to naso-pharyngeal obstructions such as diseased tonsils and enlarged adenoids. In a great many cases there is a distinct lack of coöperation on the part of the parents in the important matter of removing existing physical defects. And parental coöperation MUST be secured.

b. Parental control must be established. A review of "Lack of parental control" as a cause of undernourishment (page 228) will give one an idea of the various steps necessary in establishing better parental control. One of the biggest contributions toward the eradication of undernourishment which the home can make, is that of providing the child with a diet which is sufficient in amount and correct in the types of food which the growing child absolutely needs.

This business of being a parent is not a light task. It should demand

adequate preparation and study Accepted literature on this all-important task of rearing children should be in the hands of every parent. Magazines such as *Hygeia* and *Children* will give much valuable information to the parent who is sincerely interested in the task of rearing healthy children and worthwhile citizens. The parents should study how best to interest their children in the "Game of Health." Also the old style teaching by precept should be dropped for the more efficacious form of teaching by example.

In many cases, well-meaning parents have found that, after careful study of the various writings of food experts, their child does not react favorably to the newer methods of child-feeding. Now a great deal of common sense must be used in rearing children. This situation demands the use of it. A child loves to occupy the center of the stage. In families blessed by a single child the parents have studied rather arduously, though in many cases superficially, and have found out the kinds and amounts of food that a child should have. The rule that a child should have one quart of milk per day is interpreted to mean that the child will suffer materially if on a certain day only three-quarters of a quart are consumed by the child. But it must be understood that a child's appetite varies—as the appeitite of the normal adult does. If the child refuses the last of his milk or all or part of his spinach, the tears and pleadings of the anxious mother and the coercion of the verbose father will only focus the spotlight of attention on the child. The child receives unusual attention. He tries to secure this attention again by refusal to consume all of his glass of milk. A bad habit is started. This could have been avoided if the parents had realized that an occasional glass of milk unconsumed or a vegetable not eaten and no fuss made about it would not injure the health of the child. If the child refuses the theoretical amount of food necessary for a child of his age, take the food away. Ignore the act, and the child does not become the center of attention. Nothing pleasurable is attached to his refusal; there is no hue and cry; he will not repeat it very often.

In large families, where the parents are too busy to bother with the finical child, there is little incentive for the child to display his peculiarities. In the family which builds its every hope around the one child too much attention is focused on the unfortunate offspring. The parent who, within the hearing of the child, explains to her husband or her neighbor how "peculiar" are the dislikes of the child for spinach or milk or green vegetables soon finds that her child develops more severe dislikes and peculiarities toward these articles of food. Moreover, the father who rages about the "awful-tasting" spinach or who remarks that he does not care for certain vegetables, may expect to find his young hopeful exhibiting like tendencies. Great care should be exercised to prevent the child (and the year-old baby) from forming the habit of "not liking" certain foods.

Thus common sense is necessary in interpreting the writings of child specialists. Children differ. These individual differences should be studied. The theories, which in themselves are ideal, must be put into practice by the aid of common sense and good judgment. Good salesmanship is necessary in many cases. Dishes should be served in as attractive form as possible. Fancy nomenclature may make a dish appetizing to the child; "Red Grange delight" may prove an alluring name for carrots. The business of rearing a child demands careful study and common sense application of theory.

c. Where dietary errors are the outstanding cause of undernourishment, a vigorous attempt should be made to correct these faulty food habits. Parents should provide the growing child with the following foods:

(1) At least one pint of milk. More if it can be taken without omitting other necessary foods.

(2) Potatoes and two other vegetables (green leafy vegetables or tomatoes).

(3) Two kinds of fruits. (One fruit should be fresh.)

(4) Cereal in the form of bread or breakfast food. (Whole grain products should be used frequently.)

(5) Egg or meat or fish at one meal a day. (Protein is needed, but 'border-line toxemia" should be avoided. Eggs every day for breakfast may be too concentrated a proteinous diet.)

(6) Butter (not oleo) at every meal.

(7) A few simple sweets at the end of the meal. (These may be plain cookies, raisins, dates, figs, jelly, molasses, brown sugar, malted nuts, maple syrup or honey.)[1]

The above seven specific food requirements should be met by the home. When the home fails to meet these food requirements, supplementary feedings are necessary. This is done in many schools by school lunches. The lunches are served at cost, in cheerful rooms (not in a dark basement), and the individual child who cannot pay for the lunches is supplied free without the knowledge of the other pupils. Civic organizations are generally able and willing to handle this financing.

The school lunch is an ideal means of teaching the child to eat the foods which he fails to eat at home. The incentive of seeing other children eat spinach, carrots, cream soups, etc., will often cause the finical child to "try it." Gradually he will be taught to eat and enjoy the articles of food which are usually lacking in the diet of the undernourished child.

These lunches may be substituted for a noon meal in cases where a child must travel some distance to the school building, or they may be a simple morning lunch. These supplementary lunches are said, by many, to spoil

[1] Summarized in part from Work of U. S. Bureau of Home Economics.

a child's appetite for the following meal, and this may be true in many individual cases. A number of experiments have been made to determine what type of lunch produces the greatest gain in weight. The mid-morning lunch of one medium sized orange and two graham crackers gave the greatest (statistical) gain. One-half pint of milk and two graham crackers form the average school supplementary lunch, and secure satisfactory results in the majority of cases. At best, the school lunch is simply an admission that the home feeding is lacking either in quality or quantity, or both.

d. Overfatigue must be avoided. Rest and proper diet are needed in the majority of undernourished cases. The child who is undernourished and constantly "on the go," must be taught to rest and relax. Home chores and extra heavy school programs tax the physical and mental strength of the child. The school curriculum must be fitted to the child and not the child to the curriculum. Late hours and a heavy social program also tend to overfatigue the child. It is recommended that a definite rest program be enforced as follows:

(1) Rest period of fifteen minutes before and after each meal.

(2) Relief from nerve-taxing activities. (Walks in the fresh air and sunshine with cheerful companions.)

(3) Recreation of the "large muscle activity" type, in the open air. (Swimming, running, etc.)

(4) Sufficient sleep in well-ventilated room in the following ratio:

Age	Number of hours
5 to 6	13
6 to 8	12
8 to 10	11½
10 to 12	11
12 to 16	10

(5) Clothing should be of a nature which will protect the child from cold and thus conserve his energy, while at the same time it will not be heavy enough to fatigue him. Lighter and porous clothing should be worn indoors, and woolens and woolen socks outdoors when the weather is cold.

e. Faulty health habits must be corrected. Younger children should be taught positive health habits with a view to correcting bad ones. Older children may be taught the principles underlying their various habits. This applies especially to food habits. The younger child must be corrected in his faulty food preferences; the older child can be instructed in the principles of proper diet and food values.

The question of proper health habits should be settled, to a large extent, before a child enters school—though this does not mean that no further training can be given after a child is six or seven years of age. The young

child is receptive to positive health instruction and the positive side should be stressed in preference to the negative. A child can learn how to clean his teeth properly as well as he can learn how to brush them carelessly. The same applies to the common health rules. The earlier that the instruction in proper health habits is begun, the fewer will be the number of faulty health habits which must be broken.

4. *Additional Methods of Treatment of Undernourishment.*

a. Clinics for undernourished children are valuable. Various organizations will be found most coöperative in giving information on this phase of treatment, as for example, The American Child Health Association of New York, The Elizabeth McCormick Memorial and the National Dairy Council of Chicago, and the Nutrition Clinics for Delicate Children of Boston.

Nutrition clinics have been very successful in combating undernourishment. The weekly weighing and measuring allow for close supervision of the child's growth. Also the parent's presence at the examination and during the instruction period is very helpful in educating the parent in parental responsibility. In fact, where parents do not attend clinics, the gain in weight is not so high as at the majority of clinics where parents do attend. When the parent is present, he investigates carefully the cause of the gain or of the loss, measures the causes of weight gain against the causes for weight loss, etc., and makes, in conjunction with the nutrition worker, a more earnest attempt to alleviate undernourishment.

b. School classes for undernourished children are desirable. The open-air schools and open-window rooms have proved their worth in combating malnutrition. Children are allowed sufficient rest periods (one and one-half hours of work and then a rest period). The significant fact about the open-air rooms is that there has been an increase in the mental growth as well as the physical growth of the children in them. When the Home Economics Department has taken over the work, greater gains have been noted than when the regular classroom teacher attempts the task of conducting the school nutrition classes. The school has a certain responsibility in the matter of health of the school child. Dr. Beard [1] considers this responsibility under five general heads:

(1) It should not injure health.

(2) It should give instruction in hygiene.

(3) It should supervise and take inventory of the physical condition of the individual child.

(4) It should give exercise to develop strong bodies and proper social qualities.

(5) Its program should possess sufficient vitality, thoroughness, and tact to reach the home and community through the child.

[1] Beard, J. H., "The School and Public Health," *School and Society*, July, 7, 1923.

The open-air or open-window school attempts to fulfill the five responsibilities listed above.

When it is not possible for a special class or room to be given over to the undernourished children, each child should be weighed and measured, at least in September and March, and every month if possible. An accurate scale is a necessary part of the equipment of an up-to-date school. A word of advice, suggestion, or congratulation as the weighing and measuring process is conducted by the teacher often helps tremendously; and the use of stars (red stars for regularity in lunches, blue for regularity in rest periods, gold for greatest gain, etc.), may be of great aid in rousing the interest of the child in overcoming undernourishment. Many schools have special report cards which are filled in monthly, showing the child's height, standard weight, and his actual weight. On the reverse side, spaces are given for the parent's signature and the following (Amn. Child Health Assn.) health rules:

A full bath oftener than once a week.
Brushing the teeth at least once every day.
Sleeping long hours with windows open.
Drinking as much milk as possible, but no coffee or tea.
Eating some vegetables or fruit every day.
Drinking at least four glasses of water each day.
Playing part of every day out of doors.
A bowel movement every morning.

Whatever may be the school program for the relief of undernourishment, there must be sufficient administration to assure its practical application. In too many cases the program is entirely theoretical. The combined co-operation of the community, the school board, teachers, parents, and pupils is necessary to insure success of the school program for the relief of undernourishment.

c. Good health should be required before a child may secure his working papers. Chicago and many other cities require proper health standards before granting working papers to the child who leaves school to work. The importance of health FIRST is gradually being realized. From personal experience at the "Arden Shore Camp" at Lake Bluff, Illinois, the writer can say that industry has been saved a great labor turn-over by the correction of the health habits of the children who have been sent by the Board of Education of Chicago to this camp to be taught their academic subjects and proper health habits. Modern business and present-day industry demand strong men and women. The school children who must leave school at the end of the elementary or high school training should be made fit to withstand the stress and strain of modern business and industry.

d. The child's interest must be aroused. The child must be made to see the joy, strength (for boys), and beauty (for girls) that come with abundant health. The competitive spirit may be utilized in interesting a child in his health and nutrition. One room may compete with another for the greatest weight gain per month. One child may compete with his own record (what he should weigh and what he progressively gains, etc.). The use of graphs to show what a child should gain and what he actually gains are very helpful in stimulating interest in the game of health. Health step ladders (each rung denoting one pound) arouse the child's desire to see his name ascend higher and higher on the ladder. Posters showing what a child gains when he corrects his undernourished condition are helpful in stimulating interest in weight gaining.

e. Actinic rays (ultraviolet rays) may prove valuable. While conclusive figures showing the beneficial effects of actinic rays in malnutrition are lacking, the sporadic experiments show great possibilities for the actinic ray as a curative agent in certain forms of undernourishment.

f. Physical education is excellent for the undernourished child. Exercise alone may not produce the best results in the majority of cases of undernourishment. For the child who fails to take any form of physical exercise there is, no doubt, a good reaction on metabolism through physical exercise. In many cases, however, the undernourished child is overactive, and the rest and relaxation phases of physical education are especially needed for him.

Cases of poor body mechanics and undernourishment are best treated by using physical education subsidiary to medical care, diet, rest, etc. Poor body mechanics can be corrected only when the individual's strength is sufficient to maintain the correct body mechanics position after the child has learned what this correct position really is.

The aim of physical education for the undernourished child is not to develop large muscles. It is to increase organic strength and vitality. With the correct aim in mind, the physical educator must recall the effects of exercise on the organism (see page 50). General hygienic exercises (walking, etc.) tend to increase the efficiency of the circulatory, respiratory, metabolic, nervous, and eliminatory systems. These exercises must be light enough to prevent fatigue and excessive breaking down of the body tissues, and good body mechanics must be maintained throughout the exercises in order that the vital organs may work most efficiently.

The following are offered as specific exercises for malnutrition:

(1) Position: Correct standing position.

Action: Flex both forearms on upper arms, exhale. Extend forearms to original position, fingers to rear and palms facing the floor; inhale.

Remarks: This exercise is to be done slowly.

(2) Position: Correct standing position.

Action: Raise arms forward to front shoulder level, up over head (reaching toward ceiling); inhale; circle arms backward to original position; drop to heels; exhale.

Remarks: Abdomen must be drawn in and head held erect throughout the exercise.

(3) Position: Correct standing position, except hands on hips.

Action: Side kick dance. Raise right leg out to the right side. Hop once on left foot and then swing left foot to the left side as the right foot is brought to the floor. Immediately hop on right foot and swing right foot out to right side again as left foot is brought to the floor.

Remarks: A few counts are sufficient at first. Proper rest should follow this exercise.

(4) Position: Lying on back on floor, knees bent, heels close to buttocks, hands at sides.

Action: Raise both arms up toward ceiling and over head on floor in line with the body. Reach in line with body and inhale. Return arms to sides; exhale. Relax and repeat.

(5) Position: Correct standing position.

Action: Squat to a half knee bend as forearms are flexed on upper arms (same movement as exercise number one). Exhale. Rise to original position and inhale.

Remarks: This exercise is to be done slowly.

(6) Position: Lying on back on floor, hands at sides.

Action: Slowly flex right knee to chest, assisting with hands, and exhale. Return right foot to a position twelve inches off the floor (leg straight), as left knee is being drawn to chest. Alternate right and left knees. Inhalation is made as knees pass each other on the change of position.

(7) Position: On hands and knees (one-half prone leaning rest).

Action: Lower chest to floor and exhale. Return to original position and inhale.

Remarks: This exercise is done slowly. Abdomen must be retracted throughout the exercise, back is straight, elbows are close to sides as body is lowered.

(8) Position: Standing. Feet apart, hands above head, fingers clasped, arms straight.

Action: With a continued reaching upward movement, bend body first to right side, then up and then to left side. Exhale as body is bent; inhale as body is erect.

(9) Various calisthenic exercises may be given to the undernourished child providing the exercises are done slowly. Static movements and light imaginary resistive movements aid in slowing down the speed of the exercises

and tend to give much needed bodily development while still taking care of the all-important organic development.

(10) Hiking with jovial companions in the fresh air and sunshine, light games such as indoor baseball (played outdoors), golf, bathing, etc., are some of the more preferable activities which will be found very beneficial in malnutrition cases. The main cautions should be for moderation and sufficient time for rest after exercise.

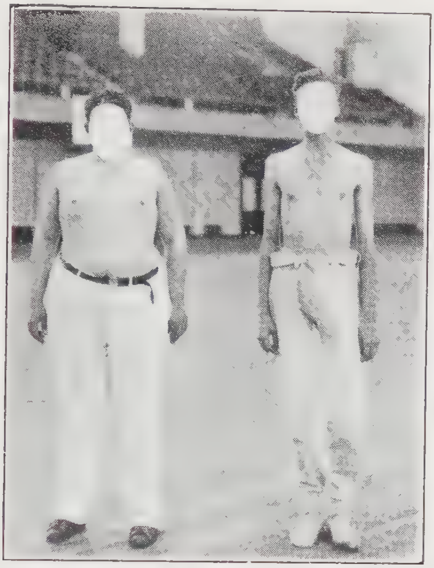
Following play or exercise, a cold mitten friction (60 degrees F.) should be used on the body. This is followed by a "rub-down" with a coarse towel and a rest of from fifteen minutes to one hour. If exercises are taken preceding a meal, ample time should be allowed for a rest of at least one-half hour after the bath before eating.

The rest preceding the meal is of utmost importance in malnutrition. When a child is allowed to play until the last minute, he must necessarily rush to "wash-up" before sitting down to the table. His body is not receptive to food. It is fatigued, and further fatigue results when food is taken into the stomach. Proper assimilation is essential for proper nourishment, and an ample rest preceding the meal makes the body more receptive to the food which is eaten and insures better nutrition.

Vigorous athletics are contraindicated for students who are undernourished. The lighter forms of activities should be substituted, and physical educators should be more firm in the manner in which they apply this rule. Many basketball players on high school teams are below the standard for their age and height. The question of whether the more vigorous type of athletics is best suited to the individual's needs and capacity should determine whether basketball and basketball tournaments should be indulged in by boys who are underweight. The child's immediate task is to develop a strong, healthy body. Although underweight is not the *only* basis for determining the individual's health it should be seriously considered as a vital health index. With the combined efforts of the community, the home, the school, the medical and physical education forces, and the interest of the child himself, there will be a diminution in the number of malnutrition cases throughout the United States.

II. OBESITY

Obesity or overweight is a condition in which the body is twenty per cent. or more above the ideal normal weight for the body in question. (Figures 58 and 59.) While not so serious a condition in children as it is in adults, obesity is not only a social handicap but also lessens physical activity and resistance to disease. The obese student is, in many cases, lower in honors



A. B.

FIGURE 58

A. Obesity
B. Underweight and functional heart disturbance

FIGURE 59
Obesity

than the student of normal weight. The number of failures is generally larger in the obese group.

A. Causes of Obesity

Despite the various reasons for obesity that are advanced, the question of the exact cause of it is still unsettled. Some of the more generally accepted causes are as follows:

1. Habitual intake of more energy-producing food than the activity of the body can take care of.
2. Glandular disturbances.
3. Existence of an anomaly of fat metabolism. ("No characteristic change in the basal metabolism of the obese." [1])
4. Middle age and lessened activity.

B. Symptoms of Obesity

Obesity symptoms arise largely from the extra burden of weight which the system has to carry and the handicaps under which the vital organs must

[1] Editorial, "What Causes Obesity?" *Jour. A.M.A.*, p. 1003, September 27, 1924.

labor. The work of the heart in obese individuals is increased. The feet are weakened by the superimposed burden of excess weight. The balance of the body is maintained at a mechanical disadvantage. Other symptoms are as follows:

1. Shortness of breath.
2. Changes in the body contour.
3. Lessened power of endurance.
4. Diminished activity.

C. Treatment of Obesity

1. Determine the condition of the body by a careful medical and physical examination.

2. Determine what the individual should weigh. The Baldwin-Wood table may be used for children. It is more difficult to recommend a satisfactory weight table for adults. The ordinary weight table gives averages and not ideal weights, and average tables lead one to suppose that an increase of weight with an increase of age is a sign of abundant health. Studies by Dr. Dublin show that the most favorable mortality rates are to be found among individuals whose weights are slightly higher than the averages for ages up to thirty years of age. Thus the average weight of a young man of twenty years of age, five feet ten inches in height, is usually given as 149 pounds. The ideal weight would be 161 pounds. A man at fifty years of age should weigh, according to the average table, 171 pounds. According to the ideal table, the same man at fifty should weigh 158 pounds. (See Figures 60 and 61.)

According to Dr. Dublin, "The amount below average increases with advancing age, and at the age of 50 individuals appear to be at their best when their weight is as much as 30 to 40 pounds below the average."[1]

The ordinary weight tables should further be interpreted by making due allowance for the particular type of individual who is being classified. A heavy-set individual with large bones will weigh more for his age and height than the thin individual who has a small frame and small bones.

3. Reduce the food intake or change the food combinations to afford the necessary bulk and sufficient but less nourishment. It is easier to change the food combination and then gradually diminish the food intake. The immediate reduction of the amount of food will generally bring hardship on the patient, and therefore the reduction of quality of food is recommended.

Obese individuals should be instructed as to what types of foods are fattening and what are not fattening. Some obese individuals, hearing that fruits are not fattening, eat alligator pears. They might just as well drink

[1] Dublin, L. I., *Statistics Bulletin,* Metropolitan Life Ins. Co., 4:3, March 23, 1923.

WHAT A MAN SHOULD WEIGH (Ideal Weights—not averages) WHAT A WOMAN SHOULD WEIGH

Height	19 yrs.	20	21 22	23 24	25 29	30 34	35 39	40 44	45 49	50 over
5′ 3″	129	130	132	133	135	135	133	131	129	128
5′ 4″	133	134	136	137	139	139	137	135	133	132
5′ 5″	137	138	140	141	143	143	141	139	137	135
5′ 6″	141	142	144	145	147	147	145	143	141	139
5′ 7″	145	146	148	148	151	151	149	147	145	143
5′ 8″	150	151	153	154	156	156	154	152	150	148
5′ 9″	155	156	158	159	161	161	159	157	155	153
5′ 10″	160	161	163	164	166	166	164	162	160	158
5′ 11″	166	167	169	170	172	172	170	168	165	163
6′ 0″	172	173	175	176	178	178	176	174	172	169
6′ 1″	178	179	181	182	184	182	179	177	177	175
6′ 2″	184	186	188	189	190	190	187	184	182	181
6′ 3″	190	192	194	195	197	197	194	191	189	187

Height	19 yrs.	20	21 22	23 24	25 29	30 34	35 39	40 44	45 49	50 over
5′ 0″	114	115	115	116	117	120	119	118	117	116
5′ 1″	116	117	117	118	119	122	121	120	119	118
5′ 2″	119	120	120	121	122	125	124	123	122	121
5′ 3″	122	123	123	124	125	128	127	126	125	124
5′ 4″	125	126	127	128	129	131	130	129	128	127
5′ 5″	129	130	131	132	133	135	134	133	132	131
5′ 6″	133	134	135	136	137	139	138	137	136	135
5′ 7″	137	138	139	140	141	143	142	141	140	139
5′ 8″	141	142	143	144	145	147	146	145	144	143
5′ 9″	145	146	147	148	149	151	150	147	148	147
5′ 10″	149	150	151	152	153	155	154	153	152	151
5′ 11″	153	154	155	156	157	159	158	157	156	155
6′ 0″	158	159	160	161	162	164	163	162	161	160

These weights are without clothing. Clothes weigh from six to eight pounds. It should be borne in mind that these weights are for **persons of average frame and muscular development.** Some allowance should be made for the heavier or more slender types of build.

FIGURE 60

Average Height and Weight of Women at Different Ages

Height	19 yrs.	20	21–22	23–24	25–29	30–34	35–39	40–44	45–49	50–54
4 ft. 10 in.	98	102	106	110	113	116	119	123	126	129
11 in.	103	107	109	112	115	118	121	125	128	131
5 ft.	109	112	113	115	117	120	123	127	130	133
1 in.	113	115	116	118	119	122	125	129	132	135
2 in.	116	118	119	120	121	124	127	132	135	138
3 in.	120	121	122	123	124	127	130	135	138	141
4 in.	123	124	125	126	128	131	134	138	141	144
5 in.	126	127	128	129	131	134	138	142	145	148
6 in.	129	130	131	133	135	138	142	146	149	152
7 in.	131	133	135	137	139	142	146	150	153	156
8 in.	135	137	139	141	143	146	150	154	157	161
9 in.	138	140	142	145	147	150	154	158	161	165
10 in.	141	143	145	148	151	154	157	161	164	169
11 in.	145	147	149	151	154	157	160	164	168	173
6 ft	150	152	154	156	158	161	163	167	171	176

Average Height and Weight of Men at Different Ages

Height	19 yrs	20	21–22	23–24	25–29	30–34	35–39	40–44	45–49	50–54
5 ft.	107	110	114	118	122	126	128	131	133	134
1 in.	112	115	118	121	124	128	130	133	135	136
2 in.	117	120	122	124	126	130	132	135	137	138
3 in.	121	124	126	128	129	133	135	138	140	141
4 in.	124	127	129	131	133	136	138	141	143	144
5 in.	128	130	132	134	137	140	142	145	147	148
6 in.	132	133	136	138	141	144	146	149	151	152
7 in.	136	137	140	142	145	148	150	153	155	156
8 in.	140	141	143	146	149	152	155	158	160	161
9 in.	144	145	147	150	153	156	160	163	165	166
10 in.	148	149	151	154	157	161	165	168	170	171
11 in.	153	154	156	159	162	166	170	174	176	177
6 ft.	158	160	162	165	167	172	176	180	182	183
1 in.	163	165	167	170	173	178	182	186	188	190
2 in.	168	170	173	176	179	184	189	193	195	197

Prepared by Thomas D. Wood, M.D. Height without shoes. Weight with moderate amount of clothing.

FIGURE 61

"top milk." On the other hand the obese individual must get sufficient nourishment. The minimum food intake is as follows:

55 grams of protein. (100 grams is found in three and one-half ounces of lean beef.)

30 grams of fat.

20 grams of carbohydrates.

This minimum essential will give 570 calories. Moreover, if the obese individual eats slowly, less food will be required to satisfy the appetite.

4. *Exercise.* Care must be taken in obese cases to prevent overwork of the heart. The heart is already doing a herculean task in keeping the obese system going. Slow exercises are used to build up the underweight individual, but it is necessary in obese cases to resort to more rapid movements which will cause increased respiration and, with the better oxygen exchange, increased metabolism throughout the body and more vigorous function of the vital organs. The following are specific exercises for obesity:

1. Position: Lying on back, hands at sides, knees bent, heels on floor close to buttocks.

Action: Exhale and draw the abdomen well in. Inhale and raise the chest and keep the abdomen drawn in.

2. Position: Same as number one except legs are straight.

Action: Alternate knee flexion, assisted by hands. Exhale as knee is flexed.

Remarks: This may be done with the heel of the straight leg on the floor until the individual develops better exercise tolerance. Then the heels are kept off the floor throughout the exercise. When this progression can be done without labored breathing, both knees may be drawn to the chest and clasped with both hands. This movement is completed by extending both legs out straight on the floor and both hands above the head on the floor, in line with the body. Further progression can be made by keeping heels off the floor throughout the exercise.

3. Position: Standing, with both feet apart and hands straight above head.

Action: With a continuous upward reach of the hands, bend the body to the right side, then up straight and then to the left side.

4. Position: On back, legs straight and hands above head on floor, in line with body.

Action: Come to a sitting position, draw abdomen well in, reach over toward toes with both hands and exhale. Place hands on abdomen and slowly return to supine position; stretch hands above head, relax and repeat.

5. Position: Prone leaning rest position.

Action: Flex right knee to chest, placing right foot flat on floor, between

hands. Left knee is straight. Exhale. Return to original position and repeat with left foot. (Fig. 62.)

Remarks: Progression is made by flexing both knees to chest. Further progression may be made by, first, squatting, and then assuming the prone leaning rest position, then lowering chest to floor, then taking the prone leaning rest position, then squatting, and finishing in the standing position.

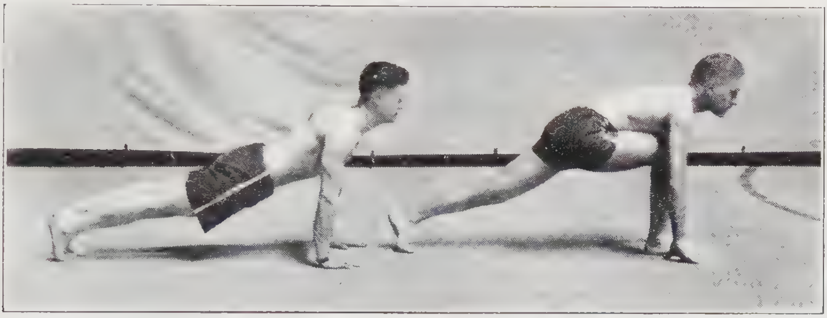


FIGURE 62

Prone leaning rest. Knee flexion

(Exercise No. 5)

6. Position: Facing the wall exerciser (chest weights), hands above head and clasping handles of machine.

Action: Bend body forward and attempt to touch toes with handles of exerciser. Exhale. Return to original position, keeping abdomen well in.

FIGURE 63

Exercise No. 7

7. Position: Lying on right side, head resting on right arm.

Action: Flex both knees to chest and clasp with left arm; exhale. Return legs to original position and stretch left hand above head in line with body. One-half the number of counts are done on the right side; the individual rolls to the left side and completes the second half of the number of counts. (Fig. 63.)

Remarks: Progression is made by doing the exercise first on one side and then on the other. This changing from side to side is really an exercise in itself—for obese individuals.

8. Position: On back, knees flexed on chest, hands under head.

Action: Keeping knees together roll thighs to right side, almost touching floor; exhale. Return to original position, inhale, and roll thighs to left side. (Fig. 64.)

9. Stationary run, with a *high* knee lift.

10. Position: Standing with feet apart and hands above head.

FIGURE 64

Exercise No. 8

(Note position of feet)

Action: Twist trunk to right side (keep hips facing front), bend right knee and touch floor outside of right foot with both hands; exhale. Return to original position, inhale, and repeat to other side.

11. Medicine ball throwing. A great deal of exercise may be secured by the use of a six-pound medicine ball. The attempt is made, not to hit the individual with the ball, but rather to throw it so that he must *reach to catch it*. If the ball is thrown so that he must catch it six inches above the head, the leverage action of the weight of the ball and the arms extended above the head gives a valuable stretching of the abdominal muscles. The receiver throws the ball from the position in which he catches it. With a series of high and low balls, vigorous large muscle activity is secured.

The following is a sample prescription for an obese college student whose heart is in good condition, and who has no hernia or kidney complication.

a. Restricted diet.

b. Exercise program, taken five days per week.

   (1) Correct breathing exercise (see exercise number one under specific exercises for obesity).

(2) Flexion of both knees to chest, from supine position. (Exercise number two under specific exercises for obesity. Last progression.)
(3) Body bending, side to side. (Exercise number three.)
(4) Squat, prone leaning rest, lower chest, prone leaning rest, squat, stand. (Full progression of exercise number five.)
(5) Breathing exercise. (Number one, but with arms raised forward upward and over head on floor in line with body on inhalation.)
(6) One side. Lifting both knees to chest. (Exercise number seven.)
(7) Twist and bend over to foot. (Exercise number ten.)
(8) Stationary run.
(9) Breathing exercise, in the standing position.
(10) Sit up from supine position. (Exercise number four.)
(11) Three minutes of medicine ball throwing.

c. Warm bath, followed by a cold one and a vigorous rub-down.
d. A walk of thirty minutes to one hour after the evening meal.

The bath for the obese case should be one which increases metabolism. The hot bath causes a certain amount of perspiration, but the cold bath causes the body to send heat to the skin to offset the temperature of the cold water. Thus energy is required and metabolism is increased by the cold bath. For the obese person who is fairly robust, the bath may be divided into a short cleansing bath (100 degrees F. for one minute) and then cut the temperature of the water to 80 or 90 degrees F. for two minutes and finish off with one minute at 60 degrees. This is followed by a vigorous hand rubbing of the skin surface and finally a vigorous rub-down with a coarse towel. This procedure is used before the student exercises when his schedule will allow the necessary extra time. When a stimulating bath precedes the exercises the body is thoroughly awakened and gives better response to the various exercises.

D. Obesity a Menace to Health

Although obesity may not be serious in the youth, it should be checked because it may become a definite health menace in adult life. A slight excess of weight is considered favorable to health in the individual of less than thirty years of age. But after thirty this is not the case. The greater number of individuals are less active than they were before thirty years of age. There is no need to argue that one *should not be* less active after thirty years of age. In actual practice activity is lessened after one reaches thirty. With this lessened activity there is not always a lessening of food intake. Thus, although the bodily processes are not stimulated to action by regular physical activity, enough food is eaten to satisfy the food requirements of

one who is doing heavy labor. This excess is stored in the body as fat. The body must work harder to take care of this extra burden. Normal functioning of the vital organs is difficult. The former activities which stimulated the various systems of the body are no longer indulged in. As a person grows older, his added weight becomes a serious menace to health. Medico-Actuarial tables report a much higher death rate in obese individuals of 45 years of age than in individuals of normal or slightly below normal weight.

E. Obesity "Cures"

With the possible exception of constipation, obesity is a condition for which most of the average laymen think they know the best method of cure that has ever been invented. The bald-headed man who buys a sure cure for alopecia from the bald-headed barber is wise compared with the gullible individual who at last realizes that his once sylph-like figure is growing old horizontally. The latter snatches at anything. Patent medicines guaranteed to cure obesity range all the way from various "salts" to be used in the bath up to special chewing gum. The American Medical Association has been active for some time in exposing many of these fake remedies, but their growth is like that of the dragons of old, for when one head is cut off, nine grow in its place. The obese individual finds the advertisements of these patent medicines very attractive because he is promised that he may eat as much as he desires and not bother with any exercise. What could be sweeter! The two favorite pastimes of the average obese (eating and inactivity) are not to be molested. Unfortunately these obesity cures are not only worthless but many are dangerous. The dangerous ones contain thyroid or drugs which should be prescribed only by a physician.

F. Slower but Surer Weight Reduction

The reduction of excess weight demands effort on the part of the obese individual. He should first have a careful medical examination. He must regulate his diet. He must exercise. When an obese individual fulfills the three requirements listed above, weight reduction may be assured in the average case of obesity (endocrine cases excepted).

Many obese individuals feel that they are regulating their diet when they take but two meals per day. They omit breakfast and allow themselves only a light lunch and a dinner at night. But an examination of the lunch and dinner menus usually reveals that as much or even more food is consumed in the two meals than would be consumed if three lighter meals were taken. The lunch in a two-meal schedule may be really light but the dinner at night is heavy enough to make up for the long fast from the dinner of the night before. The body has been without food for approximately eight-

een hours and has then been given only a slight amount. Therefore by the time dinner is served, the victim attacks it with all the vigor of a starving man. After the repast is over, an overstuffed chair receives the overstuffed diner, and the metabolic processes labor to take care of that large amount of food.

Many obese individuals, who have read of the possibilities of *rapid* reduction by patent medicines, feel that they are not accomplishing anything unless a marked reduction follows their first attempt at exercise and diminished food intake. They should remember that the organs are supported by attachments at the spine and by surrounding mesentery. As a person has allowed himself to become obese, he has been less active, and consequently the organs have not been called upon to function vigorously. The organs become weak and lacking in tone, and Nature supports them by shelves of fat, thus relieving them of strain. Rapid removal of fat removes the support of the weak organs, and this is not recommended. The question of how fast the individual may reduce depends upon the restoration of tone in the organs which have been supported by obese tissue. It is best, in the average case, to be satisfied with from one to two pounds reduction per week. One pound per week is by far the better rate. In this way 52 pounds may be removed in a year, and at the same time the health of the individual can be carefully guarded—a condition not in evidence in any of the fake reduction cures.

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CHAPTER IX

CONSTIPATION AND VISCEROPTOSIS

I. CONSTIPATION

Unfortunately from the standpoint of health and vitality our Puritanical ideas place constipation in the category of terms not used in polite society. The average person is somewhat reluctant to speak of any irregularity of the bowels. Therefore it is difficult to learn of the many cases of sluggish bowel action. Hurried medical examinations do not bring out the fact that the student is troubled with constipation. Estimates have been made that twenty-five million people in the United States are addicts of the laxative habit. It is further estimated that from fifty to seventy-five millions of dollars are spent yearly in this country for constipation remedies. Add to the users of the remedies mentioned above, the thousands who resort to home remedies for the relief of constipation, and it is easily seen that constipation is chronic with many more people than one would imagine. Further, it is only necessary to bring to mind the question which the average doctor asks on being called to diagnose and prescribe for many ailments of the body. "Are your bowels moving regularly?" This question is not always adequately answered.

Dr. Osgood,[1] stating his convictions based on twenty years' experience, says that there is the most intimate connection between health and elimination. He relates the story of the eminent Dutch physician who was supposed to have written the secrets of his remarkable success in a great book which he kept securely locked away. On his death the book was read. On the first page was written, "Keep your head cool." On the second page was written, "Keep your heart warm." On the third page was written, "Keep the bowels open." There was nothing more in the great book. Dr. Osgood writes that joint symptoms of a rheumatic nature may be the result of faulty elimination. He recommends postural training as one of the means of relief. Crampton[2] writes that plain constipation or internal stagnation is the greatest cause of organic diseases, killing more men and women in the United States than tuberculosis and cancer combined. The teachings of Dr. J. H. Kellogg of Battle Creek, Michigan, have as their main theme that faulty elimination

[1] Osgood, R. B., "Is There any Evidence to Suggest that Poor Posture Bears any Causal Relation to Poor Health in Children?" *The P. T. Review,* September, 1923.

[2] Crampton, W. C., *Physical Exercise for Daily Use,* p. 130, Putnam Co.

or bad *colon hygiene* is the important cause of the majority of cases of ill-health.

A. Causes of Constipation

1. *Dietary Errors.* Hurst [1] claims that a diet which produces insufficient mechanical and chemical stimulation of intestinal activity is perhaps the most common of all causes of constipation. A diet composed of foods which are rich in caloric value only, will not give the intestines the sufficient amount of bulk which some of the fresh vegetables give. Insufficient bulk may be due also to excessive mastication which allows nothing but liquid residue to pass into the stomach. Constipation is sometimes termed a disease of civilization due to our "refined food" habits. Purees and gruel are subject to objection because of the lack of mechanical stimulation from these foods. Pasty foods give little mechanical stimulation. A monotonous diet by its bad psychic effect may cause poor digestion and constipation. Astringent food and drinks are liable to cause constipation.

2. *Lack of Exercise.* Overactivity and subsequent fatigue may cause constipation, but, as a rule, the effect of physical activity on the bowel action is beneficial. Lack of exercise tends to lower the tone of the entire body, and especially the abdomen and abdominal viscera. Exercise with its abdominal massage stimulates the intestines and tones the viscera, resulting in better organic function.

3. *Faulty Body Mechanics.* Relaxed abdominal walls are found in the majority of cases of constipation. This relaxation of the abdominal walls results in a ptosis of the abdominal viscera and subsequent impaired function of the intestines. A person whose posture is faulty does not, as a rule, breathe deeply. Thus the diaphragm does not descend very far, and there is no compressing movement of the diaphragm on the abdominal viscera when respiration is shallow. Without tone throughout the abdomen, the act of defecation finds a weak diaphragmatic action on the abdominal viscera. Vigorous diaphragmatic action generally accompanies the normal bowel movement, and correct body mechanics with its deeper respiratory accompaniment favors normal bowel action.

4. *Faulty or Insufficient Reflex Activity of the Intestines.* The causes mentioned above produce a deficient peristalsis movement. Drugs, by their paralyzing influence on the normal nervous mechanism of the intestines, dull the reflex activity which is necessary for normal peristalsis. Habitual use of purgatives or excessive use of stimulating foods causes a subsequent depression of the reflex activity. This depression may be noticed after a severe purging of the bowels; the bowels may not move for two or three days following the purging.

[1] Hurst, A. F., *Constipation and Other Allied Intestinal Disorders,* p. 86, Oxford Press.

5. *Laxatives.* These must be listed separately as a common cause of constipation because of the false or artificial reflex peristalsis movement which they produce. When laxatives are used, the normal stimulation to bowel action is supplanted by the artificial stimulation of the laxative. Gradually the system depends on this artifical stimulation. The succeeding doses of laxatives become larger and more powerful as the system loses its normal reflex activity. Heroic or long-continued doses of laxatives cause a catarrhal condition of the intestines.

The laxative of years ago was a repulsive dose; many adults may well remember the nauseating castor oil consumed. The present-day laxative, however, may be taken in the form of sugar-coated pills or chewing gum, and therefore tempts to the habit of depending on artificial stimulation by their very pleasantness. The use of one particular, well-advertised, and over-used proprietary laxative starts many children on the artificial bowel stimulation habit. Good health habits, regularity at stool, and proper foods should make unnecessary the use of laxatives for children. If the habit is formed, the doses should be gradually reduced and finally discontinued entirely. If one is in doubt as to whether an artificial bowel stimulation is necessary, the advice of the family physician should be sought.

6. *Irregularity in Answering Nature's Call.* When the desire to evacuate is manifested, the bowels should be permitted to evacuate. If the call is unanswered, the feces become dry and hard. When the call next comes, following the forcing of more fecal matter into the rectum, evacuation is resisted by the dry, hard feces which have been retained in the rectum.

The question of autointoxication from retained fecal matter is a subject of much debate. Kellogg and others claim that there is danger from absorption into the system from retained fecal matter. Alvarez takes the opposite view, saying that the liver should strain the blood from the digestive tract before it goes through the system. And experiments on healthy individuals have failed to show autointoxication from retained fecal matter. It is evident, however, that a nervous reaction, lowered vitality and fatigue, lessened mental efficiency, and other resistance-lowering factors manifest themselves in a body which does not regularly and systematically evacuate its fecal matter. For those whose health is not especially good it is well to consider the dangerous possibility of a further lowering of resistance from retention of fecal matter.

7. *Hurried Defecation.* For the normal individual defecation takes but a few minutes. Owing to various irregularities in many individuals, however, a complete evacuation is not always secured in the normal time. Thus a residue is left in the descending colon. This residue becomes hard and dry and offers difficulty when the next evacuation is attempted. Laziness and failure to arise from bed in time to take care of the normal bowel move-

ment causes hurried defecation. This habit of incomplete evacuation is described by Hurst [1] as "Dyschezia."

8. *Additional Causes of Constipation.*

a. Unnatural position in defecation. (Insufficient abdominal pressure.)
b. Extreme labor in warm climates.
c. Insufficient fluid intake.
d. Melancholy and worry. (Psychic constipation.)
e. Hot food and drinks.
f. Fasting and irregularity in eating.
g. Kinks and adhesions in the intestines.
h. Continued use of opiates.

B. Symptoms of Constipation

1. Headache, lassitude, fatigue posture, lessened mental efficiency, general fatigue, etc.
2. Flatulence (intestinal flatus).
3. "Rheumatic joints." Constipation is often a symptom of disturbances in parts of the body remote from the bowels, such as the stomach, gall bladder, etc.
4. Offensive breath. (This may be due to carious teeth, etc.)
5. Gastric disorders.
6. Restless slumber.
7. Muddy complexion.
8. Strong odor in urine.
9. Sluggish bowel action.
10. Hemorrhoids.

C. Treatment of Constipation

1. *Prevention.* Avoidance of abuses which cause constipation.

2. *Good Health Habits.* A strict adherence to the laws of good personal hygiene.

3. *Removal of the Cause or Causes.*

4. *Proper Mental Attitude.* Too severe effort may inhibit the voluntary and reflex parts of the defecation mechanism. Certain erroneous ideas (size of stool in proportion to amount of food eaten, etc.) should be eliminated. Many people feel that a slight difficulty in evacuation should be treated with a purgative. Patience and persistence generally bring results.

5. *Proper Diet.* The diet should fit the individual case. When the alimentary tract is inflamed, non-irritating foods such as purees should be used. In the ordinary case of constipation without inflammation, the diet

[1] Hurst, A. F., *Constipation and Allied Intestinal Disorders,* p. 142, Oxford Press.

should be rich in cellulose or roughage and chemical irritation. Vegetables, fruits, grape juice, sugars, fats, whole wheat, bran, and other laxative foods should be freely used. The diet should provide sufficient nourishment for the body needs. In some cases a thorough cleansing out by an enema should precede the change in diet.

6. *Enemas.* The use of the enema dates back to the early Egyptians. Enemas are useful in relieving a stoppage in the lower end of the large colon. The indiscriminate use of enemas should be discouraged. Abuse of the enema treatment results in a dilatation and weakening of the colon and often a chronic hypochondriac condition. The type of enema and the frequency of use should be determined by the physician.

7. *Massage and Bathing.* Direct massage is usually given when the patient is lying on his left side, with the knees and hips semi-flexed. The operator applies the finger tips of both hands on the lower part of the descending colon. By pressure and spiral kneading from the sigmoid flexure up toward the left cœliac flexure and then across the transverse colon to the right cœliac flexure, the impaction is broken. The massage movement is then from the right side of the abdomen, across the transverse colon, and down the descending colon toward the sigmoid flexure. This method is found helpful by its action of first breaking the impaction and then tracing the colon toward the rectum.

Whitney [1] offers a procedure for the relief of constipation which is applicable only to the evacuation of a fecal mass in the lower rectum, close to the anal sphincter, but hard to move because of its size or density, or both. Digital pressure is used for *remolding the fecal mass.* The patient takes the ordinary position at stool. The second and third finger of the left hand presses with slight force on the thin distended tissues between the coccyx and anus, and through this on the fecal mass directly beneath. The pressure exerted is not for the purpose of expelling the mass, but solely of changing its shape. As soon as the mass is in proper form for expulsion, the abdominal pressure is quickly effective. Dr. Whitney's method is found very helpful in cases of painful hemorrhoids where the passage of a large fecal mass will irritate the tender hemorrhoidal tissue.

Internal bathing is helpful in cases where insufficient fluid intake is one of the causes of constipation. One quart of water at body temperature and containing a rounded teaspoonful of salt gives a mild chemical stimulation to the intestines.

External bathing in the form of cold tonic friction to the abdomen heightens the circulation, increases the respiratory efficiency, and causes intra-abdominal pressure and a subsequent stimulation of the defecation mechanism.

[1] Whitney, H. B., "A Valuable Manipulation for the Relief of Constipation," *Jour. A.M.A.*, 82:33, January 5, 1924.

The hot and cold (Scotch) douche to the abdomen gives the above results plus the massage action which results from the water pressure.

8. *Exercise for Constipation.* For passive exercise the Sinusoidal current (11 to 14 contractions per minute) is helpful in stimulating peristalsis without causing the fatigue which may accompany active exercise.

Active exercise such as walking in the country, golf, tennis and horseback riding are excellent procedures for agitating the body, toning the general circulation, and accelerating intestinal activity. To be sure, overindulgence in any form of the above activities may, through general fatigue, cause constipation; but, because of the more prevalent habit of underexercising, little caution is needed against overexercising by those who are troubled with constipation.

Hurst speaks of exercise as follows, "Regular exercise in the open air is one of the most important means of preventing constipation. It increases the appetite, strengthens the voluntary muscles of defecation, and stimulates the intestinal movements by producing rapid changes in the intra-abdominal pressure. It has also a most important mental effect, as it diverts the thoughts from business cares and household worries, the important factor in many cases of constipation, and it helps to prevent hypochondriasis, which is always liable to develop in constipated patients."[1]

The average prescription of the outdoor activities of hikes, tennis, horseback riding, etc., is not within the reach of all individuals. In many cases the individual is fatigued and too weak to engage in the more vigorous forms of healthful activity. For this group definite rest must be given and certain forms of light calisthenics. When the individual is weak or when outdoor activity is not possible, certain remedial exercises are offered. The principle in exercises for constipation is that of stimulating the defecation mechanism; and this achieved through a combination of twisting, compression and stretching exercises:

1. Position: Standing, feet apart, arms side shoulder level.

Action: Windmill exercise. Twist the body to the right side and touch right foot with the left hand, the right hand being stretched straight up over body toward the ceiling, exhale. Return to original position, inhale, and repeat on other side. (Touch left foot with right hand.)

2. Position: Same as in exercise number one.

Action: Twist the body to the right side, lean slightly over the right knee, raise both arms up over head, in line with body, inhale. Return arms to side shoulder level, exhale, twist body to left side, and repeat arm movement.

Remarks: Keep the knees straight and the hips steady throughout the movement. All twisting is done above the hips.

[1] Hurst, A. F., *Constipation and Other Allied Intestinal Disorders,* p. 376.

3. Position: Standing, feet together, arms straight above head.

Action: Twist the body to the right side, place right hand on the right hip. Keeping left arm close to left ear, bend body down toward right knee. Touch left hand to right foot, and exhale. Recover with a reaching movement of both arms, inhale, twist to opposite side, and repeat with left hand on left hip and body bending toward left knee. (See Fig. 33, p. 147.)

Remarks: Keep knees straight throughout the exercise.

4. Position: Lying on the back on the floor, hands at sides, legs straight.

Action: With the assistance of both hands, alternately flex and extend the knees. (Keep heels off floor.)

Remarks: Progression is made by flexing both knees together.

5. Position: Same as number four, except keeping arms above head in line with body, on floor.

Action: Assume a sitting position and reach over toes with finger tips; exhale. Return to original position and stretch. Inhale and repeat.

6. Position: Standing with feet apart and hands above head, thumbs locked.

Action: With a continuous upward reaching movement, bend the body to the right side; exhale. Lift arms and return to original position. Inhale Bend to left side.

Remarks: The lower back must be straight and the abdomen drawn in throughout the movement. This is more easily accomplished if the trunk is tilted slightly forward (10 degrees) from the hips.

7. Stationary run, with high knee lift.

8. Position: Regular standing position, except with arms side shoulder level.

Action: Kick right foot toward left hand, exhale, and return foot to floor. Repeat kicking movement on opposite side (left foot toward right hand).

9. Position: Sitting on a low stool.

Action: Churning movement. Keeping hips and head steady slowly force middle of trunk to left side, then forward, then to right side and then to rear. Repeat, going in opposite direction.

Remarks: The body must not slouch on this exercise. The attempt is made to keep the head in a stationary position and allow the movement to be made in the trunk and abdominal areas.

10. Position: Regular standing position.

Action: Step to right side and place right hand behind back. Swing left hand over head (left arm against left side of face, forearm resting on head). Bend body to right side and exhale. Return to original position and inhale. Repeat to opposite side, using reverse arm positions.

11. Position: At stool.

Action: Restrain an imaginative defecation movement. This exercises the levator ani muscles.

The exercises of supine lying and raising both legs to right angle from the body are purposely omitted because of the severe action on the abdominal group. Heavy abdominal exercises cause abdominal and intestinal fatigue.

The following is an exercise program for a student who is constipated and has poor posture and poor muscle tone:

1. Correct lying position (on back, knees bent, abdomen in). Practice deep breathing.
2. Exercise number 4. (Alternate knee flexion.)
3. Exercise number 6. (Body bending side to side.)
4. Exercise number 9. (Churning movement with trunk.)
5. Exercise number 2. (Twist and arm raising.)
6. Stationary run for ten seconds.
7. Breathing exercise (standing).
8. Exercise number 5. (Sitting up and touching toes.)
9. Exercise number 8. (Cross kicking from standing position.)
10. Breathing exercise.

The education of the student is necessary for complete success in the treatment of constipation. His coöperation is essential. Then the daily habits of the student should be revised, as far as possible, to conform to the principles which tend toward better health. With reasonable coöperation in matters of correct diet, medication where needed, good body mechanics, and rational exercise the average constipation case shows very satisfactory improvement.

II. PTOSIS (Visceroptosis)

Abdominal relaxation and sagging of the abdominal viscera is a condition which is found in many adults. Neglect of the body generally and a listless posture have caused an abdominal relaxation and weakness throughout the abdominal area. Years of "just sittin'" leave their mark on a great many adults. A congestion of the various abdominal organs, general debility, lowered resistance, and rapid onset of fatigue usually accompany cases of ptosis. The condition is seen in many school and college students who have refrained from physical exercise and neglected their bodies.

A. Causes of Ptosis

Hereditary weakness, diminution of intra-abdominal pressure, rickets and other childhood disorders result in ptosis in the child. Poor posture,

errors in diet, high heels, inactivity, and weakness following operations result in ptosis in the adult. Constipation is frequently associated with ptosis, but the relief of constipation does not necessarily mean the relief of ptosis. The relief of ptosis, on the other hand, favors the cure of constipation when constipation is caused by weakened abdominal muscles and relaxed viscera. Constipation may be listed as a cause of ptosis when one considers the fullness and weighing down of the intestines in constipated individuals.

B. Treatment of Ptosis

1. Remove the cause, if possible.

2. Prevent stretching of the muscles in the standing position. This may be done.

   a. In the older individuals by rest and support(special corset).
   b. In the younger individuals by exercise and tonic treatments to the relaxed parts.

3. Correct the pelvic obliquity. (See p. 71.)

4. Avoid constricting clothing which interferes with circulation and prevents the muscles from functioning, thus causing a loss of tonicity throughout the abdominal area. Tight belts are especially harmful.

5. *Promote Somatic Vigor.* The majority of individuals with ptosis show a condition of asthenia and general debility. Mental and physical energy is expended before it has been earned. Suitable rest periods before and after meals will assist nature in restoring the physiological balance. Rests should be taken in the prone position (Goldthwait position) as follows: Lying prone with the pelvis and legs supported on a bed or couch, the upper trunk, head, and arms resting on a chair or box. The chair or box should be six to ten inches lower than the level at which the pelvis is supported.

6. Practice proper health habits. (Hygienic living.)

7. *Exercise.* Physical exercise for ptosis cases aims to raise the chest and thus lift the abdominal contents. The abdominal muscles which are chiefly affected are the transversalis and the oblique abdominal muscles. General exercise, with emphasis on correct body mechanics, abdominal retraction and hygienic exercises, are the types most used for ptosis cases. A complete history of the case is imperative in working with these cases as ptosis usually accompanies or follows some more serious condition. A careful medical examination is necessary before exercises are given. The following is a list of specific exercises for ptosis:

1. Position: Modified knee chest position. Weight is supported on the knees and forearms. The head rests in the hands.

Action: Draw abdomen up and in, tighten buttocks, and exhale. Relax, inhale, and repeat.

Remarks: Unless the case shows a flat back, the lower back should be straightened during the exhalation. If, in the older individual, a flat back accompanies the ptosis, the pelvis should be tilted at an angle of 55 degrees on the trunk.

2. Position: Supine (lying on back, on floor), knees bent, heels close to buttocks and on floor. Hands are at sides.

Action: Draw abdomen well in, raise the chest, and draw both knees to chest; exhale. Return to original position, flatten lower back on floor, inhale, relax and repeat.

3. Position: Regular standing position. Upper arms close to sides of body, forearms bent on upper arms.

Action: Slowly push both hands up toward ceiling, lifting chest and drawing abdomen well in; exhale. Draw arms back to original position as though "chinning the bar." Inhale, pause, and repeat.

4. Position: Lying on back on floor, hands under head. A pillow is under the buttocks.

Action: Raise right leg straight to right angle with the floor; exhale. Lower to original position, inhale, relax, and repeat with left leg.

5. Position: Correct standing position.

Action: Slowly slide right hand up on right side of body, lifting elbow as high as possible; exhale. Return to original position, inhale, and repeat with other arm.

FIGURE 65
Elbow lift

Remarks: Make the elbow lift the chest, and the chest in turn lift the abdomen. (Fig. 65.)

6. Position: Correct standing position.

Action: Retract abdomen, keeping chest up. Inhale. Allow abdomen to sag. Quickly retract abdomen (by contracting the lower abdominal wall) and inhale. Hold abdomen in and exhale, keeping chest up and lower back flat.

7. Position: Correct standing position.

Action: Take a full squat on toes as arms are extended out to side shoulder level and then above head. Stretch arms as high as possible, draw abdomen well in, and inhale. Return to original position in reverse order, exhale, relax and repeat. (Fig. 66.)

8. Position: Lying on back, knees bent, heels on floor close to buttocks, hands at sides. Pillow under buttocks.

Action: Draw abdomen well in, raise chest, and inhale. Hold chest high and abdomen well in and exhale.

9. Position: Lying on floor, hands at sides, legs straight.

Action: Alternately flex and extend knees, assisting with hands. (Same as exercise number 4 in constipation group.)

10. Position: Prone leaning rest position.

Action: Place right foot between hands, exhale and draw abdomen well in. Return foot to original position, inhale, pause, and repeat with other foot.

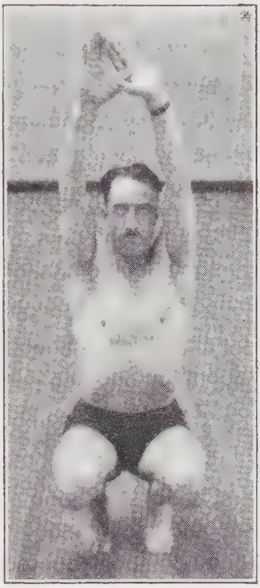

FIGURE 66

Full squat with arms stretched high

The above are typical exercises for ptosis. The emphasis is laid on lifting the chest, correcting the pelvic, tilt, and drawing the abdomen well in. Care must be exercised to prevent the student from becoming so fatigued that he is unable to retain a good position after completing his exercises. General hygienic exercises such as walking, golf, swimming, etc., should be given as soon as his condition is good enough to tolerate these activities.

In prescribing exercises for ptosis the individual case must be carefully considered. Organic vigor must be the object of all exercises. When organic vigor is established, correction of the abdominal weakness will follow very rapidly.

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CHAPTER X

ATHLETIC INJURIES

Prevention of injuries in athletics should be the watchword! The criticism that athletic games are dangerous is sometimes justified, and would be very much lessened if more thought were given to the prevention of athletic injuries. Much improvement has been made, to be sure. Football has been changed to an open, rather than a mass game, and athletic equipment safeguards some of the more vulnerable parts of the body. Still, however, some athletic coaches fail to guard their players from injuries as they might.

Training season opens with strenuous activities. Team candidates are eager to show their ability Injured players are allowed to continue in the game. Coaches attempt to determine the fitness of their players without proper medical advice. These and many other well-known abuses merit criticism.

The training season should be opened with activities which will tend to develop skill and ease of performance in a given sport, but these activities should be so light that the players are not overworked. A study of various sports reveals the fact that certain movements must be performed rapidly and repeatedly. The opening of the training season should mark the beginning of the development of the particular muscles which are to be used in these oft-repeated movements. Thus in basketball the quick pivots should be performed slowly and carefully before they need to be performed rapidly in the actual practice. Two weeks spent in training of a preventive nature will save from injury many valuable players who might otherwise break down under the stress of the game.

A player who is in good condition uses his body in a manner which protects him against injury. A player who is not properly conditioned soon becomes exhausted in a game, loses his skill, becomes clumsy, and is exposed to imminent injury. This situation is obvious at the start of training season in colleges and more especially in high schools. Beginning the training season in easy fashion and carefully conditioning the players will prevent many of the needless pre-season injuries.

Another cause of injuries is the perfunctory or entire absence of medical examination prior to the opening of the playing season. A number of high schools allow their boys to compete without a careful medical examination

of each of the players. This cannot be condemned too severely. It is unfair to the boy and his future to allow him to engage in vigorous competitive games before first ascertaining his fitness to do so. Heart disturbances, hernias, kidney condition, diseased tonsils, etc., should be carefully checked by the examining physician. In schools where there is no examining physician, the coach should insist that each boy bring a health certificate from his family physician before he is allowed to compete. Any boy with diseased tonsils or other abnormal tissue should be excluded from vigorous athletics until the abnormal tissue is removed.

Allowing a player to determine whether he is all right after he has been injured is also dangerous since it causes aggravation of many so-called minor injuries. The injured player should be removed from the game and an examination made by a physician to determine his true condition. If the injury is serious, sufficient rest and treatment should be given to put the player in good condition again. Too many boys return to vigorous play before their injuries have thoroughly healed.

On the other hand, a player who has been injured should not be allowed to lie around and grow soft if there is any chance of keeping his body in good condition. He should work those parts of his body which can be worked without aggravation of the initial injury. In the case of Pott's fracture the arms, trunk, and legs can be exercised in non-weight-bearing activities. In shoulder injuries the player can be kept in good condition by running and other activities which do not demand the use of the injured shoulder.

The health of the players can be protected by definite instruction in matters of diet, rest, elimination, etc. Clean underclothing and clean suspensories should be insisted upon. Ankles and arches can be protected by figure eight bandages and correct shoes. Knees can be protected by developing the leg and calf muscles, and by suitable knee supports. It must be borne in mind that the present-day athlete is not always a superhuman individual. He is, in many cases, only a student who desires to win his college emblem, and his flesh is not always as strong as his school spirit. Without attempting to "baby" the athlete it must be recognized that suitable protective measures will prevent many of the athletic injuries which are too frequent in modern athletics.

The Need of Knowledge of Treatment of Athletic Injuries.

Even though every precaution is taken to prevent athletic injuries, a certain number of them are inevitable. And the coach is often at a loss to know what should be done for the injuries with which he comes in contact. The following discussion attempts to answer many of the questions which the writer has been forced to answer in his teaching of prospective coaches and graduate coaches.

I. PRINCIPLES OF TREATMENT OF ATHLETIC INJURIES

For the efficient handling and restoration of function in athletic injuries, it is necessary to outline some definite *principles* of treatment of various injuries.

A. Mechanical Arrangement

In the case of injuries to joints and muscular attachments, the mechanical arrangement of the part or parts involved should be studied. The bones are the levers of the body, and the muscles and ligaments supply the force or the power which moves the levers. A ball and socket joint differs from a joint such as the knee joint.

B. Passive and Active Movement of Injured Joints

In many cases of joint injury Nature throws the muscles controlling the joint into a protective spasm which prevents further damage to the injured parts. The majority of doctors condemn the "abuse" of passive movement. It should be recognized that while a part is inflamed further movement of the part, unless in actually returning the part to proper alignment, is sure to result in further injury.

The criticism against passive movement is largely against overzealous attempts to prevent adhesions. There has been a natural reaction against prolonged immobilization, and this has been interpreted by some individuals to mean that the part must be moved regardless of the muscle spasm. The advocates of voluntary movement contend that a voluntary effort on the part of the patient is necessary for the relaxing of the antagonistic muscles which are in spasm, since this relaxation leaves the weakened muscles free to act as soon as they have power to do so. This fact is well brought out by Sherrington's experiment in which he shows that voluntary muscles are, for the most part, formed in opposing groups and that the same mechanism which causes contraction of one group also causes inhibition and relaxation of the other group.

Passive movement, if properly performed, is not condemned. Dr. Lowman [1] recommends massage to prepare a part for movement, and then adds, "As soon as it can be safely done, the arm may be carefully lifted from the splint by an assistant, and a mild passive movement of the shoulder joint made, at first *only once through the painless arc,* in each direction permitted by the splint."

A careful study of the neuromuscular mechanism will show that volun-

[1] Lowman, C. L., "Physiotherapy in Relation to Orthopædic Problems of Shoulder Girdle and Arm," *P. T. Review,* December, 1923.

tary movement is more conducive to the relaxation of the protective spasm than is the passive manipulation of the injured parts by brute strength. Acute symptoms should have subsided before passive movement is attempted; the swelling, pain, and local tenderness must have abated. When these acute symptoms have subsided, then and then only may careful passive movement be used.

The principle of voluntary movement is useful in working a knee which is slightly under the influence of protective spasm. If the operator attempts to bend the knee, resistance is felt. If the operator asks the patient to bend his knee and then applies slight resistance to the patient's heel, it will be found that the knee flexors work without the opposition of the knee extensors which is noted when passive movement is attempted.

C. Accurate Diagnosis Is Necessary

Snap judgments have no place in the treatment of athletic injuries. When a man is injured, it is the duty of the coach to ascertain his true condition, and this can be achieved only by the service of a physician. Many injuries which are really fractures are treated as sprains, with subsequent permanent impairment of function. Moreover, the use of the X-ray cannot be urged too strongly. The history of a case will determine in many instances the nature of the injury, but, for the best interests of the case, it is better to have an examination by a physician and an X-ray picture of the injured part.

To many readers this insistence on accurate diagnosis may seem finical. Why isn't the coach qualified to diagnose the case? To be sure, a few coaches may be qualified, but the greater majority are not. Yet an injured man *must* receive a careful examination which will determine his true condition. It pays! Moreover, it is the duty of the school to do all in its power to see that its boys are not functionally impaired because of neglect. The school should feel a moral responsibility for the athletes who risk their bodies for the glory of the school and the game. Some of the larger institutions have doctors upon the athletic staff who can pass upon the physical fitness of the athletes. If so, well and good! If not, one must be summoned. An accurate diagnosis must be made by a physician.

II. FORMS OF INJURIES AND PRINCIPLES OF TREATMENT

A. Fracture

The treatment of the actual fracture does not fall to the lot of the coach or physical educator, but because fractures are mistaken for sprains in many instances, it is well to know the symptoms of a fracture.

1. *Symptoms.*

a. Deformity (not always present).
b. False motion.
c. Sharply localized points of pain to pressure and motion.
d. Partial or complete disability of the part.
e. Crepitation (not reliable if near a joint).
f. Inflammation.
g. Evidence of hemorrhage.

2. *Immediate Treatment of Fractures.* First, render the injured part immovable by a simple splint or a wadding of cotton, cardboard, etc.; avoid moving a fractured part. Uniform pressure and protection are essential. Second, *call the doctor.* It is unnecessary and dangerous to attempt to reduce a fracture. If the patient shows a fever, cold applications may be applied to the head.

3. *Treatment Following the Reduction of the Fracture.* After the fracture has been reduced there is work to be done by the coach or physical educator. His job is to restore strength and function to the part. According to good authority too long retention in a cast weakens the part and delays the return of normal function. Complete rest and immobilization diminish the blood supply. The involved parts need increased metabolism. The cast in many instances can be split and treatment begun, by the third day after a fracture has been reduced. Radiant light may then be used for the production of active hyperemia, stimulative diathermy for the hastening of callus formation and *gentle* massage *by the physician* for better circulation. Massage is not given over the site of the fracture but is given to the surrounding parts.

After two weeks the physician may start light passive movement of the affected part. Before the part is moved, it should be thoroughly warmed by heat and diathermy. Following the movement, mild hot and cold water applications should be employed. Voluntary exercise is usually given by the third week.

In certain cases of overzealous athletic aspirants, a longer period of retention in a splint or cast is advised. These boys fail to realize that nature must be given reasonable coöperation in the mending of broken bones. Their main ambition is to get back into the game again, and too many are allowed to return to the game before their injuries have thoroughly healed. Their weakened parts are then subjected to heavy strain, until additional injuries result. It is the duty of the coach to give these athletes bodily exercises during the convalescent period which will keep them in good condition but which will not involve the injured parts. The services of an orthopædic surgeon are needed in all fracture cases. In this way they will be

in better condition to return to the game after the original injury has thoroughly mended.

B. Dislocations

The reduction of a dislocation should be made by a doctor and not by the coach or physical educator. Many coaches scoff at the notion that they can't reduce a dislocated shoulder. They do reduce many dislocated shoulders. But, "what price glory?" Chronic recurring dislocations of shoulder joints, torn ligaments throughout the shoulder girdle, and even broken ribs are sad testimonies to the coaches who still admit that a shoulder dislocation is *easily* reduced by their brute strength and faulty technique.

1. *Symptoms of Dislocation.*

   a. Deformity.
   b. Discoloration (degree depending on lapse of time).
   c. Motion limited and painful.
   d. Swelling or depression.

2. *Treatment of Dislocation.*

The reduction of a dislocation should be made as soon as possible, but there is no great need for rushing. A perfect reduction, in the hands of a skilled physician, is a very simple procedure (in the majority of cases). Very little force is applied. In cases of extreme spasm of the muscles surrounding the joint, an anæsthetic is given.

After the reduction the coach or physical educator can be of great assistance to the surgeon in aiding the restoration of function to the injured joint. Immobilization is not necessary for as long a period as in fractures. A light retention apparatus such as a sling, bandage, or adhesive splint may be worn. Massage and exercise should be started after twenty-four hours, and the part should be prepared by radiant light and sedative diathermy. Exercise should be given by the doctor or under his guidance. Three days following the reduction, during which time heat, massage and hydrotherapy have been given to the part and the surrounding muscles, careful passive movement should be given. This movement should be given ONCE in each direction or joint range and then only up to a point of approaching pain. The movement in the plane which originally resulted in the dislocation should be very carefully guarded. After the passive movement, the part and surrounding muscles should be treated with radiant heat, diathermy, massage, and hydrotherapy. By the end of the tenth day full range of movement should be made by active-passive movements. A slowly returning motion makes a stronger joint than a rapidly returning motion. By the end of the second week active exercises should be given and the tonic physiotherapeutic measures continued. Movement in the direction which origi-

nally caused the dislocation should be avoided for at least one month. Care should also be exercised to see that the surrounding muscles and ligaments are functioning normally. This prevents reflex atrophy of the muscles adjacent to the injured joint as these muscles are usually supplied with the same nerves as the joint itself.

C. Sprains and Strains

Every joint is liable to sprain, but those which depend on ligaments for support are more exposed to injury. The ball and socket and hinge joints are less liable to sprain than the knee, ankle, or shoulder joints. A sprain is the result of a movement of a part beyond normal physiological limits, causing a tearing of some of the fibers of the tissues surrounding the joint. (Strain is a tear of some of the muscle or tendon fibers near their joint insertion.) Whitelocke describes simple sprains as, "only those cases where, as a result of some external violence, the soft parts are overstretched or torn across, and in which no gross lesion of the bone is to be found." [1] A simple sprain is an injury of less degree and is usually unaccompanied by swelling. In the more severe forms of simple sprains there is hemorrhage and swelling.

"When the sprain is complicated by an injury to a bone entering directly into the joint, or to a neighboring epiphysis, it is called a fracture-sprain or sprain-fracture." [1] Many of the so-called "sprains" are really periosteal liftings. The ligaments are put on a stretch which is beyond their physiological limits, and a tear of the periosteum of the bone results. In other cases, one finds a sprain with a fracture near the site of the sprain. Careful diagnosis is necessary to eliminate possible fractures. The X-ray should be freely used.

1. *Symptoms of Sprains.*

a. Swelling. (Usually over the site of the injury.)

b. Pain. (Usually felt at once and intensified by movement which causes tension of the injured parts.)

c. Discoloration. (In proportion to the bleeding of the torn vessels.)

d. Poor function of the part.

e. Rise of temperature. (Local.)

2. *Treatment of Sprains.*

A review of the literature on sprains reveals a wide range of possible treatments. Some advise complete rest, and others insist on passive movement. Hot and cold applications are respectively advocated; various medications are advised for the relief of pain. Massage is advised at once by some and by others only after the first week. No doubt much can be said

[1] Whitelocke, R. H. A., *Sprains and Allied Injuries of Joints,* Oxford Medical Publications, pp. 9 and 10.

for each of the various mentioned procedures, but one must choose one definite procedure.

In cases of simple sprain in healthy, vigorous athletes, radiant heat is applied for thirty to forty minutes, and the part is then bandaged with adhesive. This adhesive bandage should not be applied in a manner which will cut off the circulation. It forms a light splint to the part and resists the accumulation of fluids, but it allows enough movement to prevent muscle atrophy. Active use of the sprained limb is permitted as soon as the pain subsides.

In cases of simple strains (fractures ruled out by X-ray), where there is considerable internal bleeding, radiant heat is applied for thirty minutes. The whirlpool bath, if available, is employed to relieve swelling and pain. Diathermy is then used for thirty to forty-five minutes, and is followed by radiant heat. Massage is then used (first starting well away from the affected area, for example, in ankle sprain the thigh, calf and toes would be massaged before the ankle). Passive movement or sinusoidal current is then used, providing the effusion has subsided. (If the part is still swollen, movement is delayed until the swelling has subsided.) The part is then massaged and swathed in cotton, over which is applied a firm bandage. The Gibney basket weave adhesive may be used in place of the cotton and ankle bandage. Figure 67.

FIGURE 67

Ankle bandage

On the second day the treatment is repeated, except that voluntary movement replaces passive movement. On the third day the same treatment is given as on the second day. (On the third day the cotton bandage [or the basket weave] should be left off and a lighter adhesive bandage applied following the treatment.)

On the fourth day the treatment is the same as for the third day. On the fifth day, providing the pain is absent and swelling is down, the adhesive is no longer used. The treatment is as on the previous day, with the exception that more vigorous voluntary movements are allowed. The part is bandaged with a light crêpe (figure eight for ankle) bandage.

One week should find the part well enough for ordinary activities. The crêpe bandage is then discontinued. Hot and cold applications are used for

another week. Within twelve days the average athlete should be well enough to participate in athletics, providing a strong bandage (figure eight for ankle) is used to protect the part from injury.

A chronic sprain is usually the result of improper treatment of the original sprain. A chronic sprain reveals two conditions:

a. Permanently stretched supporting ligaments. (These need support.)

b. Stabilizing muscles of the joint which have lost their tone, and are weak. (These muscles must be developed.)

D. Broken Bones

The coach's work in cases of broken bones begins after the doctor has decided that the break has united. (In some cases massage is allowed in three or four days, but, *always under the doctor's supervision.*) Restoration of function of the body part involved is the aim of the coach's work. A great deal of good can be achieved by prescribing general exercises of a nature which will not cause strain or movement of the injured part. These maintain good body tone. When the part is sufficiently well (*this state to be determined by the physician in charge of the case*), the coach should carefully massage the injured part. The next step is the restoration of strength to the injured part, by voluntary movements by the patient. In cases of a broken bone in the leg, non-weight-bearing exercises should be generously used before any strenuous weight-bearing exercises are attempted.

III. SPECIFIC INJURIES AND TREATMENT OF SAME

A. Dislocation of the Shoulder (Subcoracoid Dislocation)

Because of the shallowness of the glenoid cavity and its reliance on muscles and ligaments for support, this injury is common in athletics. The subcoracoid (anterior or forward) type of dislocation is the commonest form which is encountered in athletics.

1. *Symptoms of Subcoracoid Dislocation.*

a. Change in the surface anatomy of the part. The humerus is abducted, with the elbow about five inches away from the body and the long axis of the humerus pointing toward the lower margin of the axillary region.

b. Disability. This may be limited or complete. The head and face are drawn toward the damaged side, in an attempt to avoid tension.

c. Pain.

2. *Treatment of Subcoracoid Dislocation.*

a. Absolute reduction. Many surgeons use Kocher's method which is described by Moorehead [1] as follows:

[1] Moorehead, J. J., *Traumatic Surgery*, p. 211, W. B. Saunders Co.

"The patient has all clothing removed to the waist line and is seated on a stool with both forearms resting on the knees; lying down positions answer as well. The subject is told what you are going to do and instructed not to resist, and also to expire forcibly when you so direct, as this somewhat diverts and prevents muscular contraction. In reducing a dislocated right shoulder the procedure is begun by allowing the patient's elbow at a right angle to rest in the physician's left hand, the wrist of the patient being loosely encircled by the right hand. The following manipulations are then made:

"(1) The elbow is brought as closely as possible to the patient's side.

"(2) Rotation outward is slowly begun by keeping the elbow close to the side and *gradually* twisting the arm outward until the axis of the forearm is the same as the chest, or a little back of same. The head of the bone can be seen or felt (or both) to move with this procedure, and often it can be felt to slip into place. This is *the essential step,* and it must be done slowly and not jerkily. If the head of the bone does not rotate, stop at this point, and repeat the entire procedure again and again.

"(3) With the arm still rotated far outward, carry it forward, upward, and across the body—literally lift it up and in, so that it rests against the chest.

"(4) Rotate arm inward and put hand on opposite shoulder. The above steps are concisely said to consist of: (1) adduction; (2) external rotation; (3) elevation and adduction; (4) internal rotation."

Another method sometimes used is as follows: Have the patient stand, flex the forearm on his chest, holding the elbow, and then have him sit down. The head of the humerus is displaced toward the middle of the body and lower than its usual position. The act of sitting causes the patient to think of something other than his shoulder, and a temporary relaxation or "off guard" results. The physician quickly but smoothly exerts slight traction and rotation to allow the head of the humerus to slip back into its place. The use of the "Foot in axilla" method is condemned as unnecessary and dangerous.

b. Retention after dislocation has been reduced. Some surgeons strap the arm to the body with adhesive plaster. Others use a sling bandage only, the weight of the arm being borne on the side of the neck opposite from the injury. This latter method has its advantage in allowing light massage over the site of the injury and to the surrounding tissues. Radiant heat, massage (which may be given at the end of twenty-four hours), and hot and cold applications are applied daily for the first three days. On the third day, following radiant heat and massage, passive movement is used. This movement must be painless or reflex contraction of antagonistic muscles is liable to cause further injury to the part. The object of passive movement is to

put the part through normal range of movement as far as it is possible without causing pain. The shoulder joint must be firmly supported by the manipulator's one hand as he slowly abducts the arm to the side shoulder level and then raises it slightly upward. This movement is repeated daily and is followed by radiant heat and massage. If on the following day the range of movement is less than on the first day, or is painful, passive movement must be stopped. As a rule the movement is greater and less painful than on the previous day. By the end of the tenth day full range of movement should be possible.

Active movement should be used on the twelfth day and the sling abandoned by the end of eighteen days. The procedure is as follows: First, the patient is cautioned to avoid movement in the direction which caused the dislocation. Second, the sling is left off for one hour at the end of the fourteenth day. On the fifteenth day it is left off for three hours. On the sixteenth day it is left off for six hours. On the seventeenth day it is left off during the day and put on again in the early evening. On the eighteenth day it is left off entirely.

c. Restoration of strength and function in the injured part. The need for toning the parts surrounding the site of the dislocation has already been mentioned in the general discussion of dislocations. This need applies especially to the shoulder dislocations. The widely damaged area (torn muscles and ligaments) must be given the proper physiotherapeutic measures to insure proper tone of the supporting structures of the joint. Massage, therefore, should be applied to these torn parts *adjoining the shoulder* as well as to the immediate parts of the injury, and so too should radiant heat, diathermy, exercise, etc.

Following the reduction of the shoulder dislocation a peculiar relaxation or laxity of the capsule ligament is noted. The full rounded lateral surface of the upper arm is seen to be slightly depressed. Care should be exercised to tone all the parts of the shoulder in order that this relaxation may be reduced to a minimum. After two weeks' treatment, light chest, back, and neck exercises should be used. The emphasis on correct standing position must be stressed. In three weeks' time arm rotations and flexion of the pectoral muscles should be used to strengthen the shoulder girdle.

B. Chronic or Recurrent Dislocations

Chronic or recurrent dislocations are found in many cases where improper treatment follows the reduction of the dislocation. Numerous strengthening exercises are given for the shoulder region in an attempt to prevent this recurrence. During guarded movements the case responds very nicely, but as yet exercises have not protected the part against sudden and unguarded movements. An operation is usually advised in chronic shoulder dislocations.

C. Bursitis (Shoulder)

Bruises over the acromion process and vigorous use of the arm in games such as handball often produce a dull ache about the joint and, in some cases, a swelling on the front of the shoulder which is called bursitis. Lifting the arm from the body or rotating it causes pain, which is often severe enough to prevent sleeping on the affected side. The bursa most commonly affected is the one lying beneath the deltoid muscle and the shoulder joint. (Subdeltoid.) There are a number of conditions in the shoulder similar to this, and with like symptoms. The following treatment generally brings relief for these bursal conditions in the shoulder joint.

A. B.

FIGURE 68

Chronic shoulder dislocation
A. After operation
B. Without operation

1. *Treatment of Bursitis.*

a. Rest. If coaches would only use Nature's simplest remedy instead of trying to bring relief by movement to a part while the part is constantly irritated by movement, recovery would be materially hastened. The body must be relieved of the weight of the arm. A sling bandage such as is used for shoulder dislocations is ideal, and a thick padding of cotton in the axilla will assist in allowing more complete rest. Heat (radiant or diathermy) and hydrotherapy aid in promoting absorption of the inflammation and swelling. Exercise should be given only when the pain has fully subsided and then in light graduated doses. Abduction in the recumbent position is a much-used exercise.

Any low grade infection in the system (decayed teeth, diseased tonsils, etc.) delays the recovery in cases of bursitis, as it does in various other joint disturbances. The writer has seen a number of stubborn bursitis cases clear up very quickly when diseased tonsils or decayed teeth were removed. It is also not unusual to find stubborn cases in individuals who are habitually constipated.

As in the case of shoulder dislocations, the condition of the surrounding parts (supporting muscles of the shoulder) must be good. A shoulder spica

bandage gives support and rest; heat, massage and hydrotherapy promote better tone throughout the part; and general body exercises promote increased organic vigor preceding the actual exercises of the arm and shoulder. The use of a light Indian club or the revolving (nautical) wheel are forms of movement used after abduction movements can be made without pain.

D. Elbow Joint Injuries

Basketball players often complain of a swelling over the point of the elbow, which is commonly termed olecranon bursitis. Full extension of the joint is painful.

Heat and pressure of the effusion by a pad or bandage promote absorption, and allow a much-needed rest from movement and from further blows. Playing is allowed only after pain has subsided, and then the elbow should be protected by a heavy elbow pad.

Tennis players suffer from what is commonly known as "tennis elbow," caused by a strain of the pronator radii teres near the internal condyle (medial epicondyle) of the humerus. A slight swelling and definite pain may be noted over the site of the injury. Pressure by pad and bandage assists in promoting absorption of the exudate while at the same time it restricts activity in the injured muscle. Rest and heat are essential adjuncts to the above procedure.

E. Wrist Injuries

Sprained wrist. Special care must be exercised to insure an accurate diagnosis by a physician in cases of wrist injuries. A number of flail wrists result from careless diagnosing of injured wrists. Dislocation of one of the carpal bones is not infrequently seen in athletics, and a fracture usually accompanies this dislocation.

Treatment of a sprained wrist. (This does not apply to wrists which are "thought" to be sprained.) An adhesive (or adhesive over gauze) bandage is applied about the metacarpus (bones between the fingers and the small bones of the wrist), covers the wrist, and extends one-third up on the forearm. This bandage acts as a light splint, although it allows enough functional movement to provide nourishment for the injured part and to hasten absorption of the effused material in and around the injury. Massage and heat (radiant heat or diathermy) may be applied from the start. Passive movement is given on the second day. Care is taken (until the seventh day) to prevent movement in the direction which caused the injury. Active movement, while a protective bandage slightly supports the wrist, is given on the fourth day. Care is taken to avoid movement in the direction which originally caused the injury. Heavy work should be avoided for two weeks, and after this time the wrist must be protected from further strain by a

light wrist strap which is worn ONLY while the heavy work is being done. No support is given in ordinary activity after the second week. Exercises with Indian clubs should be done without discomfort by the third week. Care must be given to see that the patient coöperates to prevent muscular atrophy from disuse.

In chronic wrist conditions an X-ray should be taken to determine whether or not an unreduced dislocation or fracture exists. If there is no dislocation or fracture a light support must be worn for two to three weeks, and heat, massage, and light exercises must be given to tone up the part. At the end of three weeks the treatment should be continued for a month or more without support.

F. Back Injuries

1. *Bruises of the Soft Parts of the Back.* These are the result of kicks, or falls on or against unyielding surfaces. Rest, relief of effusion (by massage and heat), and restoration of tone are the principal steps in the treatment of these conditions.

2. *Sprains,* due to a sudden form of violence such as twisting, etc. The outstanding symptoms in these conditions are muscle spasm and pain. The spasm is best relieved by heat and rest or by movement opposite to the contracted muscles. The back must then be strapped to prevent further injury. Restoration of function must be the ultimate objective of the treatment of back sprains, and this function is restored most rapidly by rest, support, diathermy and, when the pain and spasm have subsided, light postural exercises.

3. *Sacro-iliac Disturbances.* This topic must necessarily overlap that of back sprains. Much has been written (and subsequently debated) on the possibility of subluxation of joints in acute back injuries. Sacro-iliac disturbances of a general nature are far more frequent than the relatively small number of actual dislocations or subluxations. (Subluxation is considered to denote a partial dislocation of the sacrum from the ilium.) A careful diagnosis by an orthopædic surgeon is necessary to determine the exact type of injury in the majority of "low back strains" or sacro-iliac disturbances.

a. Causes of sacro-iliac disturbances.

(1) A sudden twisting which stretches, tears, or bruises the muscles and ligaments in the sacro-iliac region.

(2) A possible slight rotation of the lumbar vertebræ.

(3) Sacralization of the fifth lumbar with the sacrum and the transverse process with the ilium.

(4) Faulty body mechanics. A flat back of the fatigue posture type or extreme lordosis.

(5) Systemic infection (from diseased tonsils, etc.).

b. Symptoms of sacro-iliac disturbances.

(1) Local tenderness and pain. (Dislocation naturally gives severe pain.) Back of leg is seat of pain. Leg raising from supine position is painful.

(2) Restricted and painful movement.

(3) Spasm of sacrospinalis muscles. Body is listed to avoid weight on the joints or pull on the involved ligaments and irritated periosteum.

(4) Faulty posture. The flat back and protruding abdomen are seen in the majority of cases.

(5) Irritation of the sciatic nerve. This is due to congestion and not to "nerve impingement."

c. Treatment of sacro-iliac disturbances.

(1) Manipulation, where it is needed. It must be remembered that the orthopædic surgeon and not the chiropractor is the one to determine whether there is any subluxation.

(2) Nerve stretching.

(3) Heat in the form of radiant heat and diathermy. Galvanism is recommended by some writers.

(4) Strapping. A sacro-iliac belt, properly fitted, stabilizes the pelvic girdle and gives much needed rest. Where adhesive strappings are used, the strap should start in front of the anterior-superior spine of the ilium and be carried across a sacral pad (felt pad one inch thick covering sacrum) and around to the front aspect of the opposite anterior-superior ilium spine. Thus the body is encircled—with the exception of a few inches in front of the abdomen—below the umbilicus.

(5) Rest during the acute or painful stage. This is taken best in bed.

(6) Attention to foot posture and short leg.

(7) Exercise is employed only after the painful stage has passed, and is then used to strengthen the involved parts and prevent recurrence. A great deal of work must be done to tone the lower back and abdomen in order that this region will be strong enough to hold the body in a position which will resist sacro-iliac strain. Coördinations controlling the affected part must be made more efficient.

Various balance exercises, raising of *both legs* or flexing of *both knees* from the supine lying position, carefully executed squats, etc., are useful in strengthening the sacro-iliac region. Alternate leg raising, bending, twisting, etc., are contraindicated. Balance exercises are used when the part is strong enough, and are necessary to insure more accurate action of the neuromuscular mechanism which controls the pelvic region. Postural exercises are helpful at all times as faulty body mechanics must be considered as a definite cause of sacro-iliac disturbances. The patient should be taught how to stand, walk, and sit with the body in good position. If he drives

an automobile, he must definitely realize that a small pillow placed against the lower back will prevent back fatigue while driving. With good care in sacro-iliac strains one month should bring the patient back to health. If there has been a definite subluxation, several months will be required to restore the part to good functional efficiency.

G. Knee Injuries

1. *Anatomy of the Knee Joint.*

The knee is a hinge [1] joint allowing slight rotation outward of the tibia on the femur, as the leg is extended. When the knee is bent, internal and external rotation is allowed, as well as slight forward and backward motion. The joint is almost completely surrounded by a fibrous capsule; it is further supported by a number of ligaments, muscles, and tendons, of which the chief are as follows:

a. Anterior crucial ligament. This ligament is attached to the upper front part of the tibia and partly to the lateral (outer) semilunar cartilage and passes upward and backward to the inside of the lateral condyle of the femur. It assists in preventing forward displacement of the tibia.

b. The posterior crucial ligament. This ligament is attached to the upper back part of the tibia and passes upward and forward to the inner side of the medial (inner) condyle of the femur. It assists in preventing backward displacement of the tibia.

c. The internal lateral ligament is attached to the internal condyle of the femur and passes down to the internal condyle of the tibia.

d. The external lateral ligament is attached to the external condyle of the femur and passes down to the head of the fibula.

e. The quadriceps tendon and the patella ligament. The former is attached to the patella above and the latter to the patella below to form an obtuse angle with a constant pull outward of the patella when the knee is straight.

Between the bones of the legs and the bone of the thigh are the semilunar cartilages. These two cartilages are crescent-shaped disks, thicker on the outer than on the inner border. The internal cartilage is loosely attached to the forward part of the internal lateral ligament and firmly attached to the posterior part of this ligament. The external cartilage is not attached to the external lateral ligament.

2. *Internal Lateral Ligament Sprain and Synovitis.*

a. Causes of internal lateral ligament sprain and synovitis.

(1) Sudden strain or violence on the knee while it is slightly bent and

[1] *The knee is not a true hinge joint as it allows also gliding movements during flexion and extension.*

the foot is turned outward. This causes a further slipping of the femur on the tibia and throws a strain on the inner border of the knee joint.

b. Symptoms of internal lateral ligament sprain and synovitis.

(1) If the injury is severe, there will be pain and a marked swelling due to the tearing of the capsule, the synovial membrane, and the lateral ligament at its tibial attachment.

(2) The joint may be extended, but the movement is accompanied by pain.

(3) There is no "locking" of the knee joint.

(4) Movement is limited.

(5) There is a floating patella in synovitis.

c. Treatment of internal lateral ligament sprain and synovitis.

(1) Rest and immobilization. Adhesive overlapping is used in light cases. The most satisfactory immobilization is accomplished by a one-inch thickness of cotton (extending six inches above the slightly flexed knee and four inches below) surrounding the knee. A knee bandage is then applied over the cotton, allowing one inch of the cotton to protrude at the upper and at the lower margin of the bandage. This allows sufficient immobilization in a position of physiological rest. Weight is not borne on the foot for a period of one week.

(2) On the second day, heat (radiant and diathermy) and light massage (not directly on the knee) are applied.

(3) On the third day and up to the seventh day, heat and massage (directly on the knee) and non-weight bearing active exercises are used.

(4) The second week is spent in weight-bearing with the foot encased in a well-fitting shoe which has one-quarter inch lift on the inner side of the heel. A regular crêpe knee bandage is worn. Heat, massage, and developmental exercises are used. Hot and cold Scotch douches are applied to the knee.

(5) The third week should find the knee well on the road to recovery. Functional efficiency must be sought through the physiotherapeutic measures outlined above and through more vigorous active exercises; slow squats, supine lying with leg raising, rising on toes, etc., are useful in developing the weakened structure. The quadriceps groups should be well developed in order that the knee may "stand up" under ordinary activity.

(6) From the third week to the sixth the patient should pursue the procedures outlined in number (5), avoiding rapid twistings of the knee and other vigorous activities which are liable to cause a recurrence of the injury. If the above procedures are carefully carried out, the sixth week should find the knee in very good condition again.

3. *Internal Semilunar Cartilage Injuries.*

Owing to the loose attachment of the cartilage to the forward part of the

internal lateral ligament this cartilage is the one most often injured. When the knee is slightly flexed, the anterior portion of the cartilage is carried toward the center of the joint. In a sudden strain caused by slipping or by a weight's striking the outer portion of the bent knee, the loose attachments fail to draw the cartilage to its proper position as an attempt is made to extend the knee. The cartilage is caught between the inner condyles of the femur and tibia. In severe rotation with violence from the outer side against the bent knee the cartilage is often torn from its attachments to the internal lateral ligament.

The old idea, arising from the term "cartilage out," was that the cartilage was pulled out from between the femur and tibia. The above paragraph should make it clear that the cartilage slides toward the center of the joint when the knee is bent, and slides out or away from the center of the joint when the knee is extended. When one says that a knee is locked, he means that the cartilage is *locked in the knee.*

a. Symptoms of displaced internal cartilage.

(1) "Locking" and "giving-way" of the knee joint.

(2) Swelling and considerable pain. This pain is increased on attempting to extend the knee. If palpation is made over the site of the anterior attachment of the cartilage as the knee is slightly extended, a sharp pain is felt at this point.

(3) Inability to extend the knee.

b. Treatment of displaced internal cartilage.

(1) Absolute reduction. Numerous methods are used by physicians and surgeons in reducing a displaced cartilage. They all have one point in common—namely, to cause the displaced body to "retrace its steps." One of the most used procedures is to place the patient on his back with the injured knee flexed on the abdomen. If the right knee is injured, the physician stands on the right side of the patient and grasps the patient's right foot with his right hand while his left hand steadies the knee. The knee is flexed as far as possible and the leg is rotated inward and outward and the knee joint slightly abducted by pressure of the physician's hand against the outer side of the patient's knee. The patient is then told to extend the knee on the count of "three." After "one" and "two" the physician rotates the leg inward, and on "three" the *patient extends* the leg and the physician pulls the patient's foot with his right hand as he presses on the patient's knee and thigh with his left hand. An audible "click" is often heard as the cartilage retraces its path. The patient experiences immediate relief. If the reduction is complete, the injured knee can be straightened in the same degree that the normal knee is straightened.

(2) Following the reduction must come proper after-treatment.

(a) Immobilization and rest. The same procedure is applicable here

as in the sprained knee. The cotton encircling the knee and the knee bandage over the cotton should be worn for ten days. No weight-bearing should be allowed until the ten days have elapsed. A regular knee bandage is worn from the tenth day until four weeks from the date of injury.

(b) Massage may be started on the second day and continued daily for four weeks, or more if necessary. The bandage is replaced after massage treatment.

(c) Active movement (non-weight-bearing), remote from the injury, should be started on the second day, such as exercise of toes, foot, trunk muscles, etc. The use of active exercise and massage assist absorption of effusion and nutrition of the limb. Light active non-weight-bearing exercises are permitted for the knee after the effusion has subsided—usually from the eighth to the tenth day. Two weeks should find the knee strong enough to bear weight, providing proper shoes are worn. A lift of one-quarter of an inch on the inner side of the heel is used to relieve strain on the inner side of the knee. Walking with the feet slightly pigeontoed also assists in relieving strain. As walking is an easily performed exercise, it should be the patient's first form of weight-bearing exercise. As the limb grows stronger, he may work more definitely on exercises such as rising on the toes (for quadriceps especially), carefully executed half and finally full squats on toes, leg raising with the knee straight (from supine lying position), bicycle riding on stationary machine, etc. One of the most helpful exercises for these cases is to clasp a light medicine ball (three to six pounds) between the inner sides of the knees and, while keeping the legs straight and the toes slightly turned in, squeeze the ball with the legs (using leg adductor muscles.) Variations can be gained by employing other exercises such as leg-lifting from the supine while holding the medicine ball, or rolling from supine to prone lying position with the ball retained between the knees.

(d) Heat (radiant and diathermy). This is being used more and more for knee conditions. In cases of injured semilunars, diathermy is very helpful in relieving effusion and strengthening the injured parts.

(e) Hot and cold water. Scotch douches increase the tone throughout the knee and diminish the period of disability.

(f) Protection against recurrence. The difficulty in many cases is to convince the patient, following the reduction of the locked cartilage, that four weeks of immobilization are necessary to allow proper repair to the injured part. The knee "feels all right" in less than one week in many cases, yet without four weeks of the treatment outlined above, there is great likelihood of recurrence. For those who intend to continue in athletics shortly after four weeks have elapsed, a knee cage should be worn to resist abduction of the knee. The majority of cages allow some rotation and abduction. The various sporting goods houses have put on the market a

regular elastic bandage reënforced with hinge braces on the inside and the outside of the knee. These braces are not as firm as the leather over steel brace or cage, but they have the one advantage of giving elastic pressure and some resistance to abduction.

c. Operation upon the semilunar cartilage. In cases of recurring knee locking, an operation should be considered. As the operation is not of an urgent nature, the patient can prepare for it without haste. An operation by a skilled orthopædic surgeon should and almost always does, if proper after-care is given, result in a knee which functions well.

d. After-care following operation for semilunar cartilage or other internal derangement of the knee joint.

(1) Massage and remote active movements should be started by the fourth day. Two weeks should be the outside limit for active non-weight-bearing flexion (90 degrees or more). The patient should be walking on crutches at the end of two weeks. From the second to the third week preparations should be made for walking without crutches. In the majority of cases, a light knee bandage is worn; the shoes must be well fitting and tilted up on the inside of the heel. With the aid of exercises such as rising on the toes, half squats, etc., the crutches should be unnecessary after the end of the third week.

(2) Various other physiotherapeutic modalities such as radiant heat, diathermy, and hydrotherapy are used—as in the case of "locked knee."

(3) Injury to the knee following the third week of after-treatment must be prevented. Care should be exercised to insure correct walking. Vigorous activity is not recommended for a period of two months following the operation. By the end of the fifth week a bandage should no longer be required for the knee. The exercises given for locked knee conditions should be done without difficulty at the end of the fifth week following the operation. The common tendency, following an operation, is to bear weight on the stronger foot and leg, and this faulty weight-bearing results in disuse of the leg which most needs the work. A great deal of emphasis should be placed on strengthening the quadriceps extensor group (vastus internus especially). It is well to strive to build up the thigh and calf of the injured leg until it is as large and as strong as the other leg.

4. *Injury to the Crucial Ligaments.*

Operations for displaced semilunar cartilages often reveal torn anterior crucial ligaments. An unusually flail-like joint, with undue forward movement and rotary movement of the tibia, is noted in cases where the crucial ligaments are injured. The leg can be fully extended but the final extension is somewhat painful.

a. Treatment in cases of torn crucial ligaments. An operation is not absolutely necessary unless the following procedures fail:

(1) Immobilization for five to six weeks with the knee flexed from ten to fifteen degrees. During this period the following physiotherapeutic modalities are used:

(a) Massage and remote active movements.

(b) Heat (radiant and diathermy).

(c) Hydrotherapy (Scotch douche and whirlpool bath).

(2) Restoration of tone and function by,

(a) Non-weight-bearing active exercises after the second week.

(b) Weight-bearing exercises from the third to the fifth or sixth week. No vigorous movements until the sixth week.

5. Pre-patella bursitis (housemaid's knee).

Continued kneeling or bruising of the pre-patella bursa results in a swelling and congestion of the region directly under and below the patella. Bandaging to relieve the effusion is generally successful. If this fails, the fluid is sometimes withdrawn with a trochar or aspirator.

H. Ankle Injuries

1. *Sprained Ankle.* This has been discussed under "Forms of Injuries and Principles of Treatment," page 266. The cause is well known. The principle of treatment for sprains as advocated by the writer is not accepted by many well-known authorities. The writer has endeavored, in his work with sprained ankles, to avoid the long immobilization which is often advocated, but yet to prevent badly sprained ankles from being used too soon after the injury. It must be understood that in the case of an ankle sprain the lateral ligaments are usually torn. A torn ligament may respond to heroic treatment (bandaging and immediate use), but the majority of ankles will have a greater assurance of normal function if sufficient time is allowed for the torn ligaments to heal.

In treating sprained ankles the reader will be obliged to determine the best form of treatment according to the type of individual who has been injured and also according to the extent of the injury. An athlete in the best of condition will naturally respond to the writer's procedure of treatment much better than an individual whose muscle tone is poor. Keen judgment is necessary in determining the type of procedure which should be used for sprained ankles.

2. *Pott's Fracture.* A fracture at the lower part of the tibia and the fibula is frequently seen in athletic work. Many cases, however, fail to receive proper treatment after the fracture has been set, and an everted and weak foot results. The principles advocated for fractures should be used for the purpose of preventing poor foot function after Pott's fracture. Massage should be used as soon as the surgeon will permit. If there is good union, light passive movement should be used by the end of the second

week. Light active exercises (non-weight-bearing) may be used by the end of the third week. The foot adductors must be strengthened. Heavier active exercises may be used to keep the body as a whole in good condition.

The chief difficulty comes in weight-bearing. The patient has been wearing a soft slipper and walking with crutches. When weight is borne (usually by the sixth week), the slippers must be replaced by a well-fitted shoe. A lift on the inner side of the heel keeps the foot straight and prevents eversion and abduction. A light outside one-bar brace should be worn for about three months, to avoid spreading of the ankle mortise from pressure against the weakened end of the fibula, while the callus is still plastic. An adhesive strapping may be necessary to insure good foot position until the patient develops the proper muscle balance.

I. Traumatic Myositis Ossificans (Multiple exostoses or parosteal callus)

During football season many muscles are bruised. Bruises on the anterior surface of the thigh are commonly termed "Charley Horses." The lighter form of distinct muscle bruise generally responds to the orthodox treatment procedures of rest, heat, massage, etc. Traumatic myositis os-

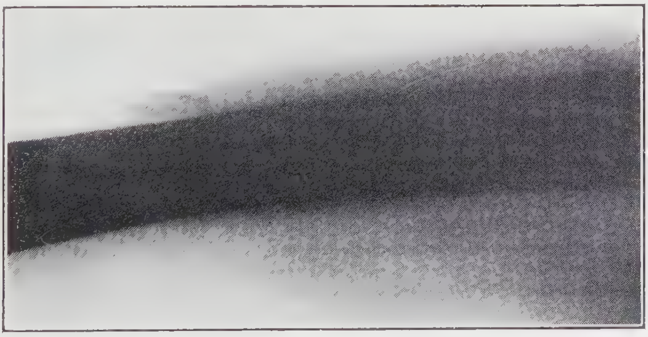

FIGURE 69

Traumatic myositis ossificans
(X-ray taken one month after injury. Note indistinct foreign shadows)

sificans is a condition which is described by Jones and Lovett as, "having its origin in an escape of bone elements induced by the original trauma and is most often the result of considerable tearing of muscular attachment from bone, accompanied by a varying amount of hemorrhage. With the torn muscular attachment, fragments of periosteum and osteogenetic tissue are pulled away, and these apparently are originators of interfibrillary and inter-

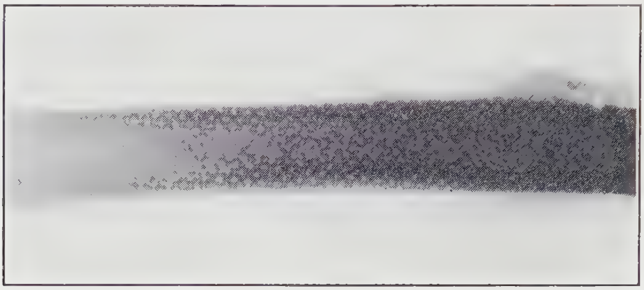

FIGURE 69-A

X-ray taken three months after injury. Note well defined foreign bone formation

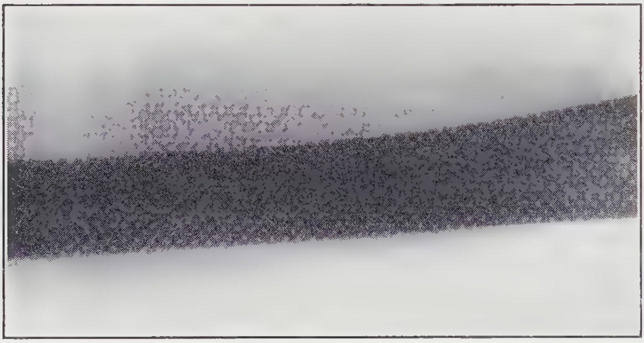

FIGURE 69-B

X-ray taken one month after operation

FIGURE 70

Bone growth removed in case of myositis ossificans traumatica

muscular septa."[1] This is more serious than a "Charley Horse," but, unfortunately, it is often mistaken for it.

Massage, instead of assisting in the removal of the clot, only increases the blood supply to the clot and augments the further growth and size of the mass.

Differing from the lighter type of bruise, traumatic myositis ossificans gives little pain at first. The limb may be heavy and move with more difficulty, and the particular muscles involved show a slight inability to function fully, become harder, and "tie up" very easily. Some cases may present marked swelling immediately following the injury.

The X-ray should be used in all doubtful cases of muscle bruise. The real condition of callus or bone usually shows up in the picture as an indistinct mass, partly or entirely separated from the bone. Rest in the early stage is the best treatment that can be offered. When the mass has really formed, an operation is indicated, but not until then. The X-ray pictures taken at monthly intervals will show the gradual development of the mass. Opposite is a picture record of a football player who originally complained of a "bad Charley Horse." Figs. 69 and 70.

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[1] Jones and Lovett, *Orthopædic Surgery*, p. 82, Wm. Wood and Co.

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CHAPTER XI

INFANTILE PARALYSIS AND SPASTIC PARALYSIS

I. INFANTILE PARALYSIS OR ANTERIOR POLIOMYELITIS

This is a flaccid type of paralysis. It is caused by a filterable ultramicroscopic virus of undetermined morphology which upon entering the body is carried by the circulation to the motor cells of the anterior horns of the spinal cord. The affliction in the anterior nerve cells of the spinal cord causes a degeneration in the lower motor nerves which emanate from these cells. The degeneration spreads to the peripheral parts of the body. Sensory impressions are not lost, but motor responses are impaired. Thus the paralysis, by affecting the motor nerves, results in a wasting or atrophy of the muscles which are supplied by the affected motor nerves.

The disease is probably spread by unrecognized carriers. Apparently healthy individuals, and also infected persons, may become carriers of the infectious material. Outbreaks of infantile paralysis tend to occur along principal interstate and intrastate travel routes. Strict isolation of poliomyelitis cases is now enforced in the majority of states.

The disease itself is, without question, a medical problem. It is the period of convalescence, after the stage of tenderness has passed, with which physiotherapy deals. For it is no longer agreed that poliomyelitis causes complete paralysis of the affected limb or limbs. Paralysis is only partial, and the partially wasted muscles can be reëducated. Muscle training has been recognized, for some time, in the treatment of infantile paralysis, but, owing to the small number of trained physical educators who were qualified to do this work, relatively little has been accomplished in convalescent infantile paralysis cases. Until Dr. Lovett's *"Treatment of Infantile Paralysis"* [1] there was little accepted literature on the subject of muscle training for infantile paralysis. But the majority of orthopædic surgeons are now agreed that, during the convalescent stage of the disease, muscle training is one of the most important modalities for restoring normal, or as near normal as possible, function to the affected parts.

The average university group will reveal a relatively large number of crippled students who have had infantile paralysis in their youth. Some cases give a history of "chiropractic rubbing." Other cases reveal the fact

[1] Lovett, R. W., *Treatment of Infantile Paralysis,* Blakiston's Son & Co.

that nothing was done to prevent deformities from following the initial paralysis. In both instances the deformity has increased until operative measures are necessary to relieve the contractures, stabilize the joints, etc., before anything can be done in the way of muscle training.

In the 1916 epidemic, infantile paralysis was generally considered as a potentially deforming condition, and definite measures were employed to prevent deformity. Many cases, however, were not thus recognized, and as a result to-day many young adolescents owe their crippled limbs to this disease at this time. The present mode of treatment recognizes that inactive muscles atrophy. The muscles which were partially paralyzed and thereby weakened are liable to become inactive for, due to the disturbance in balance between the flexor muscles on the one side and the extensor muscles on the other, there will be a stretching of the weakened muscles and a contracting of the unaffected muscles, unless steps are taken to prevent this action. The more one predominates, the more the other factor is enabled to function in the production of the deformity. The higher the degree of paralysis, the stronger will be the contraction of the antagonistic muscles and the development of a more permanent deformity. The more the weight is borne by the affected part (without proper support), the more the paralyzed muscle will be stretched and weakened. Thus, without proper care to prevent the unaffected muscles from overpowering the weakened muscles, deformity will result. In the present mode of treatment this deforming element is given careful consideration, and splints are used during the acute stage (but not until tenderness has abated) to prevent the unopposed action of the unaffected muscles.

Thus the physical educator begins his work during the convalescent stage of the disease. The objectives of his work are:

1. To prevent deformity by restoring muscle balance.
2. To prevent further deformity and to work for muscle balance when impossible to prevent deformity in the acute stage.
3. To restore normal power, function, and balance to the affected parts.

A. Examination in Infantile Paralysis

Treatment must NOT be given until a very careful examination has been made and the exact extent of injury or paralysis determined. This is done by the orthopædic surgeon. R. W. Lovett, in his *"Treatment of Infantile Paralysis,"* pages 132 to 162, gives a splendid description of the technique of the examination which must precede muscle training. He discusses the various parts of the body, and describes in detail the manner in which the parts are examined; incidentally he shows that the procedure of the examination is the same as the procedure of exercise in muscle training.

A careful examination of an affected part will show that balance has been

destroyed. If the flexors are paralyzed, it will be seen that the extensor muscles, which usually act as the complement factor of balance, have now become antagonistic to the balance of the part. The dorsal flexors of the foot are very commonly affected and show very clearly an impaired action of the tibialis anticus and the toe extensors of the dorsum of the foot. This defective condition gives the peculiar gait of flaccid foot or "dropped foot" in which the toes scrape along the ground and the heel is not placed on the ground in walking. This inability to keep the toes from scraping along the ground aggravates the action of the knee flexors which are in many cases, unopposed by paralyzed quadriceps on the front of the thigh. The action caused by the paralyzed quadriceps is also evident in the patient's walking with the hand on the knee or thigh. This is an attempt to prevent the knee from flexing and throwing him to the ground.

When the hip flexors are affected, the pelvis is brought forward on the affected side. When there is flexion deformity of the hip due to the contraction of the tensor fasciæ femoris muscle, the thighs cannot be fully extended because of this condition. In many cases the psoas muscles assist in this lordosis position making it almost impossible for the patient to maintain balance throughout the pelvic region.

B. Treatment of Infantile Paralysis

1. *During Acute or Febrile Stage.*
   a. General rest for the patient.
   b. Physiological rest for the part or parts affected, by means of splints.
2. *During Convalescent Stage.*
   a. Heat.
   b. Massage.
   c. Electricity.
   d. Muscle reëducation (passive, active and resistive movements).
   e. Supports.
   f. Operative measures.

During the acute stage of paralysis many muscles of the body seem to be paralyzed; after this stage has passed, a number of the muscles recover but still some remain paralyzed or partially paralyzed. Then if steps are not taken to restore proper balance, power, and function to the affected parts, atrophy of the muscles and bone shortening generally results. Exercise is a valuable modality in restoring proper muscle balance, power, and function to the paralyzed muscles. It is not always possible at first, however. In severe contracture cases, operative measures are necessary to restore the part to normal position. Then when the part has been corrected by these operative measures, or by braces or casts, exercise is necessary to strengthen and restore normal function to the part.

C. Specific Treatment of Infantile Paralysis During Convalescent Stage

1. *The Use of Heat.*

Heat is used in the form of radiant light and heat and diathermy. Its object is to stimulate the local and general circulation and to make possible better muscular function. This principle of better muscular function due to the action of heat should be borne in mind during cold weather; light porous clothing allows better muscle action than non-porous and heavy clothing. Heat is a good preliminary measure for massage, exercise, or electricity. Regional diathermy is used to secure deep heat in the affected muscles. Some work is being done in the use of diathermy in the region of the affected anterior cells of the spinal column.

2. *The Use of Massage.*

Massage exerts favorable action on the affected parts, if properly applied. (Chiropractic or osteopathic rubbing is not considered as massage.) Massage improves the circulation of the blood and facilitates the flow of lymph. It also retards muscular deterioration by indirectly toning the muscle. But it does not, contrary to many beliefs, facilitate the transfer of the motor impulse from the brain to the muscle; in other words, it does not increase neuromuscular power.

Caution must be exercised in the use of massage in infantile paralysis cases. It must not be used at all during the acute stage, and during the convalescent stage it must not be used too vigorously. If massage is too vigorous or too long prolonged, fatigue and loss of muscle tone result. The length of the massage séance depends entirely upon the individual patient. The majority of new cases should not be given over ten minutes and never over twenty minutes.

The use of vibration, valuable though it may be in the hands of a skillful operator, is not recommended as a general procedure. Fatigue of an affected part, due to overwork by mechanical massage (vibration), will cause a setback and delay recovery for many months.

3. *The Use of Electricity.*

Until very recently the use of electricity in the convalescent stage has been questioned, because doubtless it was ignorantly used. But the faradic current has been effectively employed where voluntary contraction of the muscle was impossible. Facial and abdominal paralysis respond favorably to electrical treatment. Too vigorous mechanical contractions are not recommended, even in the convalescent stage. The Bristow coil or high tension faradic coil with its surging current is now more generally used for mild muscular action. These contractions are given from five to ten times for

each muscle at the start, and the dosage is gradually increased until each muscle is receiving about two minutes' work per day.

Care must be exercised in the use of electricity, as well as other modalities, to *avoid a general stimulation* which causes a general action on the part of ALL the muscles involved in the general treatment. When this occurs, strong antagonists are made stronger and further deformity results. The effort should be extended entirely on the weakened muscles in order that the complementary balance between flexors and extensors shall be restored, without further increasing the action of the already overpowerful antagonists. Because of the uncertainty of the electrical treatment it is regarded as the least important of the various modalities of treatment discussed.

4. *The Use of Muscle Reëducation.*

With the use of heat, massage, electricity, operative measures, and proper bracing a gradual restoration of better position of the affected part can be achieved. There still remains, however, the necessity of restoring the cerebral motor stimulation to the affected muscles, for there must be better neuromuscular coördination. Though the sensory stimulations have not been interfered with, the motor responses must form new paths around the affected anterior horn of the spinal cord and thus take their courses to the desired muscle. A voluntary impulse must come from the brain and pass through the motor tracts of the upper neurones and finally through the appropriate centers to the affected muscles, and a voluntary contraction or extension of the affected muscles must result. Thus muscle training through physical exercise is necessary, and it becomes the task of the physical educator to effect this new coördination or better conductivity by developing, through muscle training, new paths for a more efficient neuromuscular mechanism.

The necessity of knowing just what muscles are affected should now be quite apparent. A thorough knowledge of anatomy, kinesiology, and physiology is imperative in this work, for it is folly to exercise a limb in a poor physiological position. The objective, "restoration of normal function" (education of motor neurons and increase in muscle balance and strength) should be constantly borne in mind. The necessity for accuracy and precision of movement must be emphasized and the individual who is exercising should be impressed with the necessity for coöperation. He must be shown that it is the neuromuscular coördination which is being sought, and he must be urged to assist in establishing the new paths for the motor responses from the brain to the muscle. In cases where the student can perform only part of the movement, the physical educator assists in securing a more nearly normal movement by lending his assistance as soon as there is evidence that the student's power is waning. Thus the student physically and mentally goes through a greater range of movement which eventually develops the

neuromuscular coördination to be used when sufficient strength is developed to perform the movement unassisted.

Because of the many different degrees of deformity and the various parts affected it is almost impossible to prescribe a series of exercises which might be generally useful. Lovett, in his *Treatment of Infantile Paralysis,* proceeds by first describing the examination procedure designed to ascertain what muscles are weak. Then he gives exercises—movements to strengthen the weak muscles—which will put the affected part through the same movements performed in the examination procedure. Thus if a test is made to determine whether the abductors of the foot are affected, the student will sit with the foot hanging free and the lower leg steadied by the hand, and turn the foot outward to touch the operator's fingers which are held a few inches to the outside of the foot. The exercise will consist of:

a. Everting the foot against the resistance of gravity.
b. Everting the foot against manual resistance.

Whenever possible the exercises should be performed in a manner which will take every advantage of gravity. Sliding the arms out from the sides to position above head, in line with the body, will be done more easily when the patient is lying on the floor in the supine position than when the body is in the erect position. Exercises done in a saline bath allow easier movements and less fatigue (due to the buoyancy of the water) than if the same exercises were done out of the water. The water temperature should be approximately 90 degrees F.

A word should be said about resistance exercises in infantile paralysis. The first part of the movement should be very lightly resisted. At the end of the first third of the arc of the movement, better leverage action is possible and greater resistance can be given. At the end of the second third of the arc of the movement less and less resistance should be offered as the leverage action is poor throughout the final third of the movement. Sufficient rest should be allowed between each movement to insure that no fatigue will result.

Each case must be treated individually. The parts affected must be exercised to restore proper balance and to develop sufficient strength to maintain the corrected position. Throughout the entire procedure care must be exercised to prevent fatigue, because when fatigue sets in, the unaffected muscles, enduring better than the paralyzed muscles, increase the deformity. The last movement must be as strong, or stronger, than the first. Also, in exercising an infantile paralysis case, the entire body must be considered. Good bodily development, good nutrition, a more optimistic outlook, etc.—all help in treating the individual. The great danger of treating only the local condition must be avoided.

5. *Supports.* (Braces, casts, etc.)

In order that the unaffected muscles may not cause deformity by their unopposed action, some stabilizing agent must be used. The average parent is, at first, reluctant to put a brace on a young child, but the greater number of orthopædic surgeons are now subscribing to the doctrine that the use of the limb without braces within one year is dangerous. Something must be done to prevent the unaffected muscles from taking up the slack of the paralyzed, or even partially paralyzed, muscles. The gravity thrust on the growing bones must be controlled. Braces are used to provide physiological rest of the part after it has had its dosage of exercise for the special muscles involved. And it is cheering to remember that the earlier the braces are used, the less time they will have to be worn.

Some objections against braces are the result of the use of ill-fitted braces. *Braces should be prescribed by orthopædic surgeons.* A good brace costs twenty-five to seventy-five dollars. A cheaper brace, of course, costs less, but it will not stand up under the abuse that the average child gives it. It is, in the end, more expensive than a good one. Naturally the muscular action is partially restricted while a brace is worn. In this connection it might be well to bear in mind that rest from actual weight-bearing during the first year following infantile paralysis will not result in deformity if the unaffected muscles are prevented from destroying the muscle balance of the limb. Braces do prevent the unaffacted muscles from destroying the muscle balance of the limb. In cases where a child attempts to use the limb in a deforming position, a brace is absolutely needed to prevent deformity. There are some cases of mild infantile paralysis which can use the limb without assuming a deforming position in two months following the attack. No brace is necessary in this case.

The use of the brace plus the other modalities such as heat, massage, and exercise is highly recommended. These furnish the necessary prevention of deformity and the restoration of muscle strength and neuromuscular co-ordination which will restore normal, or almost normal, function. One has but to compare a group of children, of whom half have been treated by bracing and exercise, and the other half have been allowed to get about as best they could, to determine which method should be used.

6. *Operative Procedures.*

Operative measures are usually employed after nature and the various modalities listed above have been given a chance to effect a cure of the deformity following infantile paralysis. Some authorities state that in the absence of deformity no reconstructive operative procedures are indicated earlier than from one and a half to two years. Progressive decrease of deformity contraindicates operative intervention. In less than one year, how-

ever, the operative measures should be used on the more stubborn cases. The operative measures may be summarized as follows:

a. Tendon fixation or tenodesis. (Conversion of muscles around a joint into ligaments.) In cases of foot-drop, the tibialis anticus muscle and tendon are buried in the tibia to take up the slack of the stretched tendon.

b. Arthrodesis or joint binding. This is used to stabilize a joint. It produces an artificial stabilizing or ankylosis.

c. Tenotomy or lengthening of a tendon.

d. Tendon transplantation. A non-paralyzed muscle is substituted for one which is paralyzed.

e. Osteotomy or removal of a wedge of bone.

Following any of the above operations comes the necessity of restoration of function in the part. The operation may free a contracture or stabilize a joint but it still leaves a great deal of work for the physical educator in strengthening the part and restoring neuromuscular coördination.

Figure 71

Infantile paralysis
(Both legs)

Cases of infantile paralysis cripples in the college gymnasium, showing a history of infantile paralysis fifteen to twenty years old, present a difficult problem in physical education. Fig. 71. The type which shows marked deformity cannot be given much hope for correction without an operation, and this operation should be urged. After the operation, a great deal can be done to develop new coördinations, restore strength to the part, etc. The other type of case shows a slight deformity, and much can be done for these. A thorough orthopædic examination must be made by the surgeon. Deficient muscles should be strengthened; and activities which tend to neglect the

FIGURE 71-A

Infantile paralysis
(Left leg)

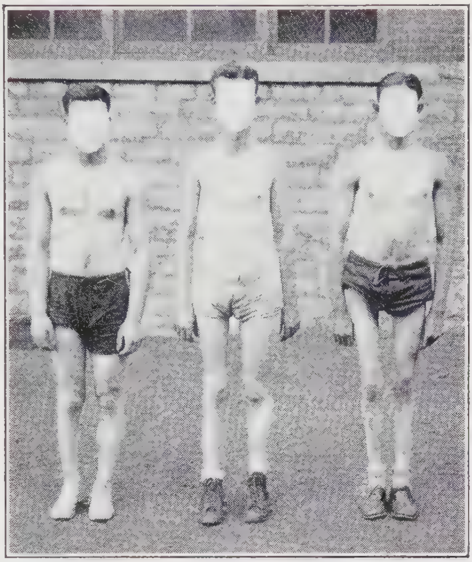

FIGURE 71-B

Infantile paralysis
(Right leg)

FIGURE 71-C

Infantile paralysis
(Right leg—with marked scoliosis as the result of the unequal leg lengths)

FIGURE 72

Spastic paralysis

weakened parts and further strengthen the strong parts, should be discouraged in favor of more intensive effort to correct the existing weaknesses.

II. SPASTIC PARALYSIS (Cerebral Paralysis, Little's Disease, etc.). Fig. 72

The term "spastic paralysis" is used to describe the various types of cerebral paralysis found among children. It includes the paralysis called "Little's Disease" and described by Little as "universal rigidity of the muscular system or of the flexor muscles only in new born infants."

Spastic paralysis may be of the following types:
Monoplegia, involving one extremity.
Hemiplegia, involving one side of the body, *e.g.*, right arm and right leg.
Paraplegia, involving both lower extremities.
Diplegia, involving both arms and both legs.

The spastic type of paralysis differs from infantile poliomyelitis in that the former is not, strictly speaking, a paralysis at all. It is a condition of hypertonicity with impaired inhibitions and imperfect coördinations. However, many cases present a picture of general muscular debility except under excitement when the flexors become spastic. The reflexes are increased (hyperactive reflexes), the muscle tonus is exaggerated, and, in the more severe forms, the child's condition borders on the idiotic. Because of the disturbance in the associated parts of the brain and the nervous system, due to the primary lesion in the motor area of the cerebral cortex, there is a loss of synergistic control, with unfixed and arythmical movements of the muscles and extremities involved.

The paralysis may be congenital or acquired. In the congenital type, the paralysis may be due to cerebral defects, hemorrhage, defective development of the pyramidal tracts, syphilis, etc. The acquired type may be caused by trauma at birth, or by some injury resulting in convulsions, loss of consciousness and paralysis; or it may develop as an accompaniment of some fever of the meningeal type. A very small number of the hemiplegia cases are congenital, but the majority of the paraplegic and diplegic are congenital.

Spastic paralysis is often called a paralysis of lost coördinations. The flexor and adductor muscles of the affected limb or limbs are in a state of hypertonicity; the extensor and abductor groups are in a state of hypotonicity. Thus there is a release of the contractile stimuli in proportion to the withdrawal of the inhibitory stimuli.

In hemiplegia the patient will be found with the arm held close to the body, the humerus rotated inward, the elbow firmly flexed, the hand flexed

on the wrist, and the fingers in the palm, holding the thumb. Supination and outward rotation of the arm and hand are restricted. The lower part of the body shows a contracture of the knee and hip, a shortened tendon Achilles, the foot in a position of adduction, and the heel raised (talipes equino-varus). In many cases of long standing (child of twelve or thereabouts), where walking has been done, there will be a distinct foot weakness which has almost resulted in a flat foot. This is especially noticeable when the muscle spasm is relieved and the weight is borne on the weakened foot.

Cases of paraplegia show, the adductor muscles being hypertonic, the characteristic "scissors gait" position or cross-legged position which makes walking difficult—or barely possible.

A. Treatment of Spastic Paralysis

Without treatment there can be little hope for improvement. Rather, the deformity steadily becomes worse. Persistent faulty use of the parts results in further weakening of the affected muscles, and increased deformity; and the hyperactive muscles, which cause the deformity, become stronger in the deformed position. Training in relaxation of the flexor and adductor muscles, and coördination of the affected limb movements must be continually stressed. Of these two the training in better coördination is more important than the development of muscle power.

The treatment of spastic paralysis may be divided into three parts:

1. *Treatment by surgical operation of the local condition.*
2. *Treatment by medical aid of the whole body.*
3. *Treatment by mental and physical education of the whole body, with special attention given to the local condition.*

The first two parts of the treatment are obviously matters for the surgeon and physician. It may be well, however, to emphasize here the fact that the physiological and pathological considerations must not be overlooked. Daily health habits must be practiced.

The mental and physical education can best be handled by the physical educator, but under the supervision of the surgeon and physician. The objectives of the physical educator's treatment must be:

1. To restore, as nearly as possible, normal limb strength and function.
2. To overcome contractures. (After a tenotomy the objective must be to maintain the lengthened position of the tendon.)
3. To stimulate and reëducate the undamaged cortical cells.
4. To reëstablish old and develop new inhibitory pathways.
5. To improve the rhythm of movements of the affected limbs.
6. To develop better neuromuscular coördinations and balance.
7. To improve the tone of the weaker muscles.

8. To liberate the personality of the patient through expression—to allow sensory stimuli to result in motor responses (*e.g.*, simple games).

9. To eradicate the "defeatist feeling," *i.e.*, to make the patient feel that he CAN do the daily tasks and duties of a normal child. (Tasks must be kept within his capacity.)

For success in treating spastic (and infantile) paralysis it must be firmly impressed upon the patient and his parents that recovery is not to be expected in a very short time. A definite program of action must be outlined. The parents must be cautioned against "trying some new movement." For example, in cases where the arm and leg are affected and large gross movements are prescribed for the parts, the parents often wish to start the fingers to working. It should be explained to them that, since the finer accessory (finger) movements are developed only after the large (arm) movements have been developed, it is therefore necessary to follow this same principle in overcoming the arm paralysis.

A régime of wholesome, hygienic, regular outdoor life is essential in the treatment of spastic paralysis. Play of the large muscle activity type is productive of general well-being, and should be stressed, while emotional stress and excitement must be reduced to a minimum.

Massage is useful only for its quieting effects on the hypertonic flexors, adductors, inward rotators, and supinators. Atrophy is present in spastic paralysis in extensors, abductors, outward rotators, and pronators, but it is not due to the same cause as the atrophy of infantile paralysis; it is due to the restriction of movement of the hypotonic groups.

Exercise Must Involve the Weaker Muscles. The motor impulses must be reëducated. "All exercises should be active for extensors, and passive for flexors. All active movements should correspond grossly to the four words: *out, over, up* and *back*."[1] For emphasis it may be repeated that this reëducation must start with the training of the larger muscles (proximal). This training of the coarser movements builds up a better base on which to develop the finer coördinations when the time is ripe for this development. This can be carried one step farther. The leg should be trained before the arm, since the use of the arm (as it is now used) came after the use of the leg. Also since the treatment of the lower limb hastens the use of the limb in walking, a pleasing psychic element aids in securing the patient's coöperation.

The Exercise Treatment Is Usually Started as Follows:

Patient Lying. The hypertonic muscles are given light stroking massage for sedation. Heat may be used to produce relaxation. When the part is

[1] Lowman, C. L., "Spastic Paralysis in Children," *Medical Life,* Vol. 29, No. 2, February, 1922.

fully prepared for the movement, the operator *slowly* puts the limb through the flexion movement. The patient does not assist in this. The patient is then asked to extend voluntarily the limb while the operator assists to secure full maximum movement. The operator completes the manipulation by gently stretching the limb slightly beyond this point. The movements are then repeated until the first signs of fatigue are noticed. After the operator has passively put the limb through the movements of abduction, outward rotation, and supination, the patient actively (assisted by the operator on the final arc of the movement) will perform the movements.

In stretching contracted muscles it must be remembered that these are the stronger muscles, and, if not properly stretched, they will resist and thus become stronger in their unbalanced position. Stretching against resistance gives a concentric exercise which develops the muscles. If properly stretched, the patient "wills" the movement, and thus assists in reëducating the motor impulses to the muscles which are actively engaged in the process.

Care must be exercised to avoid stimulation of the hypertonic groups and general fatigue. When the larger muscles are used, the principle of treatment outlined above usually brings success, and a feeling, on the part of the patient, of joy in his accomplishment.

Rhythm is cultivated by using both arms, or both legs, simultaneously. Thus if the right arm is affected and an extension is desired, both arms perform the movement simultaneously. The inhibition of the flexor groups works on both arms. Thus the coördination of the unaffected limb assists in promoting better coördination of the affected limb. This type of movement for the arm is best done before a mirror. Gradually the affected arm is exercised alone and the patient concentrates on the movement. Here the operator can be of great assistance if he will merely touch the arm as it reaches the point in the arc of the movement which is generally difficult. The light assistive touch is often just enough to allow the patient to complete the movement. The use of the metronome, with a very slow beat at first, is recommended for establishing better rhythm. In the writer's experience the phonograph is even more helpful than the metronome; the music must be of the slow waltz type (*e.g., Blue Danube*). The relaxation which accompanies a fine piece of music is very helpful in spastic paralysis cases. Also exercises may be done in a warm swimming pool or a bath tub with the water 97 to 100 degrees F. The buoyancy of the water relieves the pull of gravity and allows easier movements with less fatigue.

When weight-bearing movements can be used, emphasis must be given to the promotion of better balance and equilibrium. The hemiplegia case is clumsy and awkward, and simple large muscle movements must be performed. When better equilibrium is established, simple balance movements may be used. Some of the more commonly used movements are: kicking

a soft ball, simple barn dance steps, walking on a straight line, Hop Scotch, etc.

In cases which have undergone an operation the physical educator can assist in restoring strength to the part as well as reëducating the motor impulses which control the movements of the limbs. The principle of treatment is the same as outlined above with the exception that a splint is generally used to maintain the correction which the surgeon has secured by his operative procedure. Habits of years in spastic paralysis cases are not corrected by a surgical operation; education must assist in changing these habits. The following case is cited to show how habit interferes with the recovery, even after a very fine surgical operation has removed the tendinous obstacles to normal function:

The patient was a boy twelve years old. His mentality was very good, and his parents were very well educated. The child's left arm and left leg were typically hemiplegic. The diagnosis read, "hemiplegia at birth," leaving indefinite whether the case was congenital or acquired. The boy was given a series of exercises similar to those outlined above. After six months fairly good movement could be secured but only up to a point of tendinous intervention. Therefore an operation was advised. The operation relieved the contracted tendon Achilles and the shortened pronators of the arm, and the leg remained in a cast for six weeks and the arm in a splint for four weeks, before any treatment was given.

Upon removal of the splint the full supination and outward rotation of the hand and arm were possible. Upon removal of the cast full dorsal flexion and outward rotation of the foot and leg were possible. Heat, massage, and exercise were carefully given to restore strength to the parts while retention splints were worn daily to prevent old positions from asserting themselves. As the child regained strength, he was taught to walk correctly. After one year of treatment by exercise—both local and also general, in the form of games and calisthenics—the boy's gait was normal unless he attempted to hurry. Then the old habit of walking on the toes of the left foot asserted itself. Two years of constant effort were required to break this habit. The arm did not do so well. The child was right-handed and found it easier to do things with the normal right hand, than with the still awkward left. Numerous devices were tried to correct this habit. For example, when reading, the child was taught to hold the book in the supinated left hand; he carried books and other objects in the left hand; daily he crumpled newspapers with the left hand only; he wore a wrist watch with the watch part on the inner surface of the wrist so that a supination movement was necessary whenever he wished to see the time. The supination movement and the outward rotation movement of the arm were free, but after two years of intensive effort the old habit remains and the arm is much

smaller and weaker than the right arm. On the contrary the leg is almost normal in size and quite normal in function.

Thus it will be seen that the correction of spastic paralysis is a difficult task. The operator must constantly study the case and "keep after" the patient to make sure that he will continually do the things which will make for normal limb function. All forms of games may be used to assist in producing normal movements. The child can be taught to catch a large ball (volleyball), if a smaller ball is too difficult for him to catch; he may be taught to bat an indoor baseball; he may try basketball shooting for its extension movement. The success in each case may be partially measured by the patient's coöperation in doing at all times the things which will develop correct limb position and satisfactory motor responses. Also, health habits must be continually practiced; general body tone must be developed. In younger children the coöperation of the parents, as well as the child, is essential to success in the treatment.

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CHAPTER XII

MISCELLANEOUS DISTURBANCES AMENABLE TO RELIEF OR CURE BY PHYSIOTHERAPEUTIC MEASURES

I. ALBUMINURIA (Orthostatic)

Orthostatic albuminuria is a condition in which the urine shows albumin while the person is carrying on his daily activities but which disappears when he is allowed to rest. About three per cent. of the college students at the University of Illinois show an excess of albumin in the urine. This condition must not be confused with actual renal insufficiency or nephritis. In nephritis there is an inflammation of the kidney tissue.

Orthostatic albuminuria is found in many individuals whose posture is very poor, in many who have a family tendency toward albuminuria, and in many who engage in vigorous muscular exertion followed by cold baths.

The presence of albumin in the urine does not fully determine the condition of the kidneys, though it does show an absorption of unchanged proteins from the digestive tract. Upon the recommendation of the examining

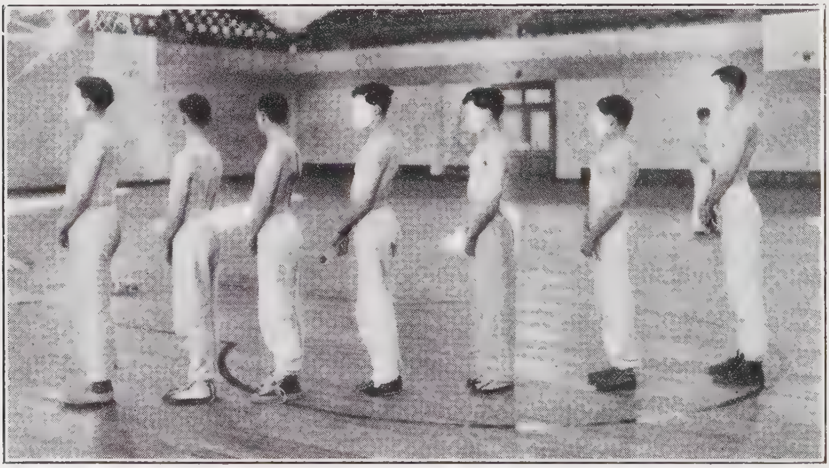

FIGURE 73

Cases of albuminuria

physician the physical educator may proceed with the following instructions for orthostatic albuminuria:

A. Treatment for Orthostatic Albuminuria

1. Avoid chilling.

2. Avoid infections. (Albuminuria often follows tonsilitis and other infections.)

3. Take sufficient rest. This does not necessarily mean rest in bed. Taking life a little easier than ordinary is ample in the majority of cases. This rest, however, should be mental as well as physical.

4. Use a simple diet. Avoid the excessive use of proteids and stimulating foods. In the majority of cases, a lessening of quantity works very well. The colon should be kept clean and constipation avoided. The old style "flushing the kidneys" with water is no longer advocated. The kidneys need rest.

5. Take sweating procedures on advice of the physician.

6. Exercise.

The use of exercise in orthostatic albuminuria is for the purpose of diverting the blood in the internal organs to the skin. This relieves the intra-abdominal-renal pressure and congestion, and thus enables the internal organs to function more efficiently. The posture of the body and the general body tone and health should be improved by exercise. The following are typical exercises used for albuminuria.

a. Position: Lying on the back on the floor, knees bent, heels close to buttocks, and the hands at the sides.

Action: Draw abdomen well in, force lower back to the floor, raise chest and exhale. Inhale, keeping this position. Relax and repeat.

b. Position: Correct standing position, except hands at neck firm position.

Action: Keeping the chest high and the body as tall as possible, bend the body to the right side and exhale. Keep abdomen well in, return to original position, inhale, and repeat to other side.

c. Position: Correct standing position.

Action: Raise right knee to chest, assisting with both hands on front of knee; exhale. Lower foot to floor and at same time stretch the body as tall as possible without rising on toes; inhale. Repeat with left knee.

d. Position: Correct standing position.

Action: Raise arms front shoulder level, then to above head, rise on toes, and inhale. Continue backward circle of arms, dropping to heels on last quarter of the circle, exhale, relax, and repeat.

e. Position: Lying on floor on back, hands under head.

Action: Slowly raise right leg to a position at right angle to the floor,

exhale, pause and slowly lower leg to the floor. Inhale and repeat with other leg.

f. Various light calisthenic movements involving the arms and legs are useful in toning up the body as a whole and drawing blood from the congested abdominal area. Caution must be exercised to prevent severe and continued muscular exertion. The student should show a slight perspiration upon completion of the exercises, but he should not be fatigued. Organic sufficiency and physical development are helpful in albuminuria cases, but the organic sufficiency must not be sacrificed for physical development. The lungs and the skin must do their share in elimination, thus taking all possible strain off the kidneys.

Any case which shows a high blood pressure and a kidney condition should be viewed with suspicion and exercised only under exact orders from the examining physician. In many cases of circulatory disturbances, where there is a passive congestion of the kidneys, exercises will be found very helpful in slightly stimulating the circulation and respiration, and thus causing a better tone of the vascular system and a lessened heart strain.

A word must be said regarding the rest procedure in kidney cases. Rest does not mean, in these cases, absolute rest in bed. For a student who is overexercising, such as an athlete, the required rest would consist only of restricted activity. For the student who is not engaged in vigorous athletics but who shows albuminuria, a correct posture and definite rest periods throughout the day will be sufficient in all but a few cases.

Bathing should be regulated. Extremes of temperature should be avoided. Short warm baths are easily tolerated whereas cold baths increase the work of the kidneys. The use of the swimming pool should be curtailed unless the water temperature is much higher than that which is found in the average college pool.

II. BLOOD PRESSURE

In 1628, William Harvey discovered the means of measuring the pressure of the blood in the vascular system. And blood pressure readings have been, and are still, used by doctors to determine the condition of the individual. But blood pressure readings are interpreted not as a complete diagnosis of the case; they are only one of the many diagnostic signs of the condition of health or disease. Blood pressure readings alone must not be taken as a final criterion of a person's condition.

The maintenance of a normal blood circulation is essential to health; permanent alterations in the circulation are either the result of disease or result in disease. Normal heart action and a maintained circulatory equilibrium are in every way interdependent. A normal circulation denotes

normal blood pressure with a normal functioning heart, normal blood vessels, and normal vasomotor regulating mechanism. Conditions affecting any one of the above will cause an abnormal circulation.

Blood pressure maintains a constant flow of blood through the system, even when the heart is at rest. The healthy individual maintains this condition without extra wear or tear on the cardiovascular system. A person with a blood pressure of 120 systolic and 80 diastolic will have a pulse pressure of 40. Thus the amount of energy expended in maintaining the circulation in excess of that required to open the aortic and pulmonic valves, and overcome the resisting pressure of 80. is 40 mm. The normal load may then be considered as 40 over 80, or 50 per cent. of the diastolic pressure. Applying this principle to a pressure of 170 systolic and 100 diastolic, we get an overload of 20 per cent. (50 per cent. being normal, 70 over 100 gives 70 per cent. or 20 per cent. overload). Thus this last example shows a condition where the system is forced to expend extra energy to maintain the body function. The normal balance is lacking, and wear and tear result.

A. High Blood Pressure (Hypertension)

In many cases this is a condition which Nature has produced for a definite physiological reason and which therefore should not be combated as a disease *per se*. The term is applied rather loosely to any condition in which the blood pressure is maintained at a level above normal. But the term "normal" must be understood to mean a relative normal, and the advice of the doctor is necessary in determining the advisability of attempting to reduce high blood pressure.

1. *Causes of High Blood Pressure.*

Crampton gives as the cause of high blood pressure, "a physiological reaction of the blood vessels to vasotonic influences which are usually toxic and act directly upon the arteries or indirectly through the nerves. These vasotonic influences are in turn caused by:

"a. Infections.

"b. Strains, acute and chronic.

"c. Poisons from the intestinal tract and from outside the body.

"d. Disharmonies, either metabolic or endocrine.

"There is usually a combination of these causes."[1]

"Intoxication" is the term used in many cases to cover the entire field of conditions caused by constipation, gastro-intestinal disturbances, overeating, etc. To the above mentioned causes may be added,

e. Poor health and faulty hygienic habits.

f. Excesses.

[1] Crampton, W. C., "Exercise in the Treatment of Hypertension," *N. Y. Medical Jour.* July 4, 1923.

g. Worries.

h. Poor posture which results in ptosis of the abdominal viscera and lack of tone throughout the splanchnic area.

2. *Symptoms of High Blood Pressure.*

Hypertension is itself a symptom and not a disease. The signs which are evident in high blood pressure are:

Accelerated pulse rate, nervousness, dyspnea on exertion, indigestion, disturbed sleep, kidney disturbances, etc.

3. *Treatment of High Blood Pressure.*

High blood pressure, *per se,* no more indicates the need of treatment, except along preventive lines, than does the presence of a heart murmur unaccompanied by other signs of cardiac disturbance. Hypertension is one of Nature's methods of compensating circulatory or visceral deficiency, and in the carrying out of her purpose she can, fortunately, not often be thwarted. A person with a high blood pressure, however, is living too close to his cardiac reserve, and a reduction is essential to prevent wear and tear of the cardiovascular system.

a. The first principle in treatment is to remove the cause, wherever this is possible. In the case of a man whose business is "riding" him and causing him to worry, it is necessary to eliminate the worry. Therapeutic treatment will bring no lasting change in the blood pressure reduction until the worry element is removed.

b. Next, peripheral resistance must be reduced. In cold weather it is necessary to provide warm clothing to prevent further chilling of the body, and vasoconstriction. Autocondensation (300 to 500 milliamperes for 15 minutes) assists in relieving peripheral resistance.

c. Rest, restricted diet (spiceless foods, diminished intake of meats and other proteids, increased vegetable and mineral consumption, lessened fluid and salt intake), and exercise must be added to the program of treatment.

Exercise in a case of high blood pressure is beneficial because it causes greater distribution of blood to the peripheral parts, sudation (sweating), and improved digestion and metabolism, as well as the psychic relaxation which all proper exercises afford. Exercises are not generally used because of the failure to appreciate their effects. To be sure, all sudden, violent, tensing movements must be avoided, and also all complex exercises which necessitate mental effort and a consequent increase of the systolic blood pressure. Moderate exercises requiring only a slight cardiac activity are helpful, and simple movements are always used instead of complex ones. In giving exercises the instructor should be on his guard for distress signals such as pallor, painful expression on the face of the patient, flushed face, palpitation, fatigue, etc.

The chief principle in exercises for high blood pressure is that of relieving peripheral resistance. The splanchnic area is congested, and exercising the peripheral parts will relieve their congestion and draw blood from the congested splanchnic area, thus distributing it more evenly throughout the system.

Exercises such as rising on the toes will draw the blood to the lower limbs. Arm exercises will draw blood to the arms. Flexion and extension of the knees in the supine position will reduce peripheral resistance throughout the legs. Exercises which are recommended for heart disturbances are applicable in cases of high blood pressure.

Exercises such as suggested above will produce a slight rise in blood pressure immediately after the exercise, but as the neuromuscular system becomes better organized and the circulatory system becomes better adjusted, a distinct lowering of the blood pressure will be evident for as much as an hour after the exercises are completed. In normal individuals the peripheral parts are dilated and blood pressure is lower than normal for as much as one hour after the termination of moderate exercises.

Games are recommended for high blood pressure cases, but they must be of the less strenuous and non-competitive type, such as volleyball, golf, horseshoe pitching, etc. The psychic element of games is very helpful in treating blood pressure cases which have as their chief cause "worry," because the individual enters into the game and forgets his troubles. For the high-tension business man and for the student who is troubled with his studies, the game element should be constantly stressed in an effort to secure not only this psychic benefit but also the expression of the physical side through large muscle activities.

B. Low Blood Pressure (Primary Low Blood Pressure)

In this condition it is not uncommon to find the patient weak and debilitated. Fatigue is evident after slight exertion. The extremities show poor circulation and chill very easily.

1. *Causes of Low Blood Pressure.*

Malnutrition, shock, chronic wasting diseases, warm climate, etc.

2. *Treatment of Low Blood Pressure.*

a. Remove the cause, wherever possible.

b. Tone the heart and general system by light exercises, games, and hygienic living.

c. Take reasonable rest periods, sufficient sleep, etc.

d. Avoid all excesses, such as tobacco, etc.

e. Use correct diet.

The exercises which are especially recommended for low blood pressure are of the same type which were recommended for *functional* heart cases.

Trunk twisting and circumduction, slow squats, light leg movements, and light games are beneficial in restoring tone throughout the system. Swimming, where water is not too cold, is found very stimulating to the body as a whole and specifically beneficial in cases of low blood pressure. Excessive swimming is, of course, not recommended.

III. HERNIA

In the erect posture the skeletal muscles, if working properly and possessing good tone, tend to hold the body erect and allow normal function of the body parts. The muscles of the back are commonly considered the supporting muscles of the trunk, but the abdominal muscles must assist these back muscles in supporting the abdominal viscera. When abdominal tone or strength of the abdominal muscles is lacking, a condition known as "hernia" may ensue.

Hernia is a protrusion of an abdominal viscus from its normal position. Inguinal hernia is the most common form. An inguinal hernia of the ordinary type passes through the internal abdominal ring which is a small opening about the size of an ordinary lead pencil, lying midway between the anterior superior spine of the ilium and the pubic bone. It leads to the inguinal canal, which is about one and one-half inches in length (in the adult), reaching almost to the pubic spine and ending in the external abdominal ring.

The internal abdominal ring is located just beneath the crescentic arch of the inferior border of the transversalis muscle. The lower fibers of the internal abdominus oblique muscle form a cover for the internal abdominal ring. The external oblique muscle fibers are split at their tendinous insertion into the pubic bone, forming a slit which is closed by the contraction of this muscle. The action of the external oblique muscle is likened to the closing of a buttonhole when the cloth is pulled taut at the ends of the long axis of the buttonhole.

"Strain" due to lifting a heavy object has been long considered the real cause of hernia; but the majority of cases which are seen in the gymnasium show a condition which is obviously due to a gradual weakening of the abdominal muscles and fascia. The abdominal muscles and fascia have given way at the weakest point, *viz.*, the inguinal rings. Dr. Moorehead [1] maintains that no operating surgeon would allow that an internal ring could be, by one act of violence, suddenly stretched enough to permit a portion of the abdominal contents to escape and then equally suddenly dilate the inguinal canal.

[1] Moorehead, *Traumatic Surgery*, p. 738.

1. *Causes of Hernia.*

a. Weakness of the abdominal muscles and fascia, caused by lack of exercise, poor body mechanics, and general weakness.

b. Relaxed abdominal rings. Gravity and internal pressure gradually cause a protrusion through the weakened parts.

c. Violent internal pressure on weakened parts. Coughing, sneezing or vomiting may create this. A sudden increase of pressure from the ordinary intra-abdominal pressure of 25 mm. up to 100 or 150 mm. may cause a protrusion if the parts are weak and relaxed.

2. *Symptoms of Hernia.*

a. A dull ache, pain, or tenderness. Very few college students *suddenly* develop a protrusion.

b. Relaxed rings. (Opening is relaxed if the index finger tip can be inserted into the external ring.)

c. An impulse on effort. (Coughing will generally produce the impulse.)

d. Enlargement.

e. Many patients present no symptoms other than that of relaxed rings. They are very much surprised when the examining physician records their condition as abnormal.

3. *Treatment of Hernia.*

No treatment should be given until the doctor has made a careful examination of the student. The doctor should then prescribe the best method of practical treatment: in some cases he may advise an operation; in others, he may recommend only the use of a truss, and exercises for toning the abdominal muscles. If an actual protrusion exists, the usual course is an operation.

A hernia operation is not serious. Many doctors perform the operation using only a local anæsthetic, and will allow a healthy student to be up and out of the hospital in nine to fourteen days. Exercise may be taken in bed for the purpose of toning the abdominal muscles and preventing abdominal weakness. The usual exercise, given at about the fifth day, is that of kicking a pillow at the foot of the bed. The movement is done very, very lightly at first. The pillow is at the foot of the bed and the right knee is slightly bent (heel remains on the bed) and then slowly extended until the foot is pushed against the pillow. The left leg is then used. Gradually increasing the duration and vigor of the exercise tends to strengthen the abdomen.

No truss need be worn when the patient leaves the bed. Heavy work should be avoided for from five to six weeks after the operation, though light work can be done in three weeks after the operation. Exercises (page 308) numbers one, two, three, four, and five may be performed twice daily

(fifteen minutes in the morning and fifteen minutes in the afternoon) during the fourth and fifth weeks following the operation. It is well in cases of hernia of some duration, to tone the abdominal muscles prior to the operation. When this is done, light breathing exercises and walking may be permitted at the end of two weeks.

If a truss is prescribed, the student should make sure that he is using it correctly. Too many people push out against the truss. The abdomen should be held in, and the truss allowed to do as little work as possible. In this way the abdominal muscles may develop tone in spite of the support. The truss must be applied while the patient is lying down; it must fit; it must not press *into* the opening but rather *cover the opening*.

The following are specific hernia exercises. They may be used following a hernia operation, in cases of loose inguinal rings which need abdominal tone, and in cases where a truss is being worn.

1. Position: Lying on back, knees bent, heels on floor and close to the buttocks, hands under head.

Action: Retract the abdomen, lift the chest, and inhale. Keep abdomen in and chest up, exhale.

2. Position: Lying on back, legs straight, hands above head on floor and in line with the body.

Action: Stretch from the finger tips of the right hand down through the right side of the body and through the right heel. The body is thus made as long as possible from the finger tips of the right hand to the heel of the right foot. Exhale. Repeat with left side of the body. Repeat with right arm and left heel. Repeat with left arm and right heel.

3. Position: Correct standing position.

Action: While holding the chest high and the abdomen in, lift the right knee towards the chest, using hands to assist lightly the movement. Exhale. Return right foot to original position with a lifting of the chest and a tensing of the thigh extensor muscles. Repeat with left knee.

4. Position: Standing with the feet apart and the hands at neck firm position.

Action: With a continuous lifting movement, bend the trunk to the right side, then erect, and then to the left side.

Remarks: Exhale as body is bent to either side. Inhale as body reaches the erect position. Avoid leaning back from the waist.

5. Position: Lying on back on the floor, both heels resting on seat of a chair or stool, hands under head.

Action: Draw abdomen well in and lift right leg straight to right angle with the body. Exhale. Lower right heel to the chair and inhale. Repeat with other leg.

Remarks: Progression can be made by lifting the left heel from the

chair as the right heel approaches the chair. This keeps both heels at an angle of forty-five to ninety degrees from the floor.

6. Position: Correct standing position.

Action: Slowly bend knees to a half squat (on toes), while at the same time stretch both arms out to side shoulder level and up to overhead. Exhale and keep abdomen in. Return to original position in reverse order and inhale.

Remarks: The abdomen must be retracted and the chest held high throughout the movement. The student must "reach" continually with both hands as the knees are bent.

7. Position: Sitting on floor with legs straight and body tilted back just beyond a right angle with the floor, hands at hips.

Action: Twist the body, from the hips, to the right side, and exhale. Twist front, inhale and repeat to the other side.

Remarks: Emphasize the stretching upward of the trunk all during the exercise. The instructor may place his hand lightly on the student's head and encourage the student to press his head up against the instructor's hand while the body is being twisted.

8. Arm exercises which tend to lift the chest, while the abdomen is retracted, may be given with good results.

9. Slow jogging may be given after the student has developed good control of his abdominal muscles. A good trunk position should be insisted upon during the jog.

Tone and poise as well as abdominal strength are the objectives of the corrective and protective exercises which are used for hernia cases.

Breathing exercises are used for their chest raising effects.

Twisting exercises are beneficial for tensing the inguinal openings. When a good chest lift accompanies the twist, an ideal and safe movement is assured.

Supine exercises with body-raising and leg-raising involve too much strain on the affected parts, and, unless done correctly, they will cause a marked impulse or pressure upon the rings. Dr. McKenzie [1] illustrates very clearly this danger. When the legs are raised from the supine position, the rectus abdominus muscles are the first to act as the heels leave the floor. The obliques are relatively inactive and forced outward by the pressure within the abdomen. After the first few inches have been passed, the obliques come into action. It is necessary, therefore, that leg-raising from the supine position be done with the body on an inclined plane (head lower than the feet) or with the heels resting on a chair or stool, or by starting with the knees drawn up on the chest and then stretched to right angle with the body.

[1] McKenzie, R. T., *Exercise in Education and Medicine*, Saunders Co., Philadelphia, Pa. (Chapter on Abdominal Weaknesses and Hernia.)

IV. INDIGESTION

Although many forms of indigestion are not amenable to relief by physio therapeutic measures, a review of the causes of indigestion will reveal many conditions which can be treated by them.

A. Causes of Indigestion

1. *Faulty Health Habits.*

2. *Dietary Errors.* Though many of these may be treated only by the physician, yet some of the following errors may be prevented by the physical educator.

a. Taking food in too large masses without sufficient mastication.

b. Eating too rapidly. Not enough time is allowed for the thorough mixing of food and saliva in the mouth. In many cases, the food is washed down with some liquid.

c. Deficient peristalsis action in the stomach. This may be caused by overloading the stomach and thus interfering with the churning action of the stomach. The stomach may become distended, and the stomach muscles weakened.

d. Disturbed balance of the various digestive juices.

e. Poor combinations of food.

f. Irregularity of eating.

g. Eating when the body is fatigued. This condition in the case of children may account for the various digestive disorders which cause them to lose weight even though they eat plenty of food. The adult who leads a sedentary life must also guard against eating when the body is fatigued. The athlete who eats a heavy meal immediately following a vigorous work-out is often subject to severe digestive disturbances.

h. Sluggish metabolism from physical inactivity.

3. *Faulty Body Mechanics.* Enough has been said about the relation of faulty body mechanics to impaired functional efficiency of the body organs for one to see the relation of faulty body mechanics to digestive disturbances. When the chest is flat, the abdomen protruding, and the vital organs of the abdominal area not in their proper places, good digestion is hardly possible. Constipation accompanies this condition in many cases and thus causes further impairment of the vital processes of the body.

4. *Psychic Influences.* Fear, worry, and kindred emotions check the normal peristalsis of the digestive system.

5. *Shallow Breathing.* This deprives the digestive system of the normal action of the diaphragm.

6. *Deficient Circulation of Blood in the Stomach.* The flow of blood to a part is in proportion to the activity of the part. Good circulation of blood in the stomach is necessary for efficient digestion, and yet an overloaded stomach may give rise to the formation of gas which causes the stomach to expand and press against the diaphragm, and in turn causes a crowding of the cardiac area and interference with the normal heart action. Any interference with the normal heart action causes a disturbance in the circulatory system.

B. Symptoms of Indigestion

Perverted appetite, gas and belching, regurgitation of sour liquids from the stomach to the mouth, burning sensation in the pit of the stomach, coated tongue, loss of weight, disturbed rhythm in the heart beat, pain across the middle of the back, especially in the morning before rising and often after meals, etc.

C. Treatment of Indigestion

1. *A Thorough Medical and Physical Examination by a Competent Physician.*

2. *Bodily and Organic Vigor.* Indigestion is not confined to the thin individual but affects the stocky type as well. The latter is troubled with indigestion due, in most cases, to overnourishing of the body and lack of physical activity. As a rule, however, the thin type with faulty body mechanics and general debility is more often affected than his heavy-set brother. Bodily and organic vigor is needed in the thin type. A better physiological balance must be established. Light breathing exercises and hygienic exercises, performed out of doors, will increase the metabolism of the body and make the digestive system more receptive to food.

3. *Rest.* Overactivity of the mental and physical processes must be checked in order that the system may have a chance to "catch up." Rest before meals allows the body to quiet down in preparation for the food which is to be taken into the system. Rest after meals is necessary to allow the digestive organs to work without interference.

4. *Correct Diet.* (*Diets should be prescribed by the physician.*)

5. *Massage.* The circulatory deficiency in the abdominal area, often resulting in a stasis, is relieved by massage which promotes better circulation, increased peristalsis activity, and increased desire for food.

6. *Good Mental Attitude.* Pessimism, melancholia, hypochondriasis, and kindred mental disturbaces have a depressing action on the body. It is often necessary to draw the individual out of his introspection and surround him with cheerful companions and cheerful environment in order that this depression may be overcome.

7. *Exercise.* In general, outdoor hygienic and recreative exercises are the ultimate aim for the individual with indigestion. Posture exercises and deep-breathing exercises are used to prepare him for them.

General movements of the trunk, with the body in good position, will favor peristalsis and develop tone in the involved area. A typical exercise is as follows:

Position: Correct standing position, except with feet apart and hands on hips.

Action: Twist the body to the right side, raise arms side up and over head, keeping body in a straight line from the left heel to the finger tips, and inhale. Return to original position, exhale, and repeat on other side.

Remarks: The arm lift is done with the abdomen well in. The descent of the diaphragm on inhalation compresses the stomach. As the body is twisted to the right side, the lift of the arms should be accompanied by a vigorous lift on the left side of the body. The abdominal viscera are drawn up, and the circulation is increased throughout the parts involved.

The churning exercise (exercise number nine in constipation series, page 255) is recommended for the organic massage which accompanies the circumduction of the trunk.

Exercises of the above type are beneficial for indigestion, but complete relief will be secured only when the body is exercising in proportion to the amount of food which is taken into the system. Exercise is necessary for the production of the natural desire for food (appetite). When the body is functioning efficiently, the digestive organs will function efficiently. Vigorous outdoor activity is not generally accompanied by indigestion. On the other hand, sedentary workers are troubled with digestive disturbances. Remedial exercises tend to offset the baneful effects of sedentary living by providing a substitute for the natural activity denied the body. Because poor body mechanics and abdominal ptosis usually are evident, emphasis should be laid on the lifting of the abdominal organs so that they can work with greater efficiency.

V. NEURASTHENIA AND VISCERAL PSYCHONEUROSIS

A. Neurasthenia

Health was formerly considered in terms of the physical alone, but with our increased knowledge of mental hygiene the importance of mental health is gradually being recognized. Many individuals with apparently sound physical bodies become nervous and suffer from "nervous breakdowns." Moorehead defines neurasthenia as, "a functional disease of the nervous system due to a large number of causes, characterized by mental and physical

incapacity for sustained effort, and presenting numerous subjective and some objective symptoms particularly connected with the cardiovascular and muscular system."[1] This condition is also defined as an organic asthenia or weakness characterized by increased liability to fatigue in all forms of activity by which the organism displays its energy.

The general term "nervous exhaustion" is commonly used to define the condition which results from neglecting to conform to physiological laws which have control over the functions of the mind and body just as the laws of gravitation control the movements of the planets. Although man recognizes the immutability of the laws of the inanimate world and the natural principles which govern animals and vegetable life, man treats himself as an exception to all living things and tries to assert his superiority over the physiological laws which govern his species. The natural, inevitable result is "nervous exhaustion."

Our present mode of high tension living is well pictured in the following poem:

THE MODERN MAN

Hurry the baby as fast as you can,
Hurry him, worry him, make him a man.
Off with his baby clothes, get him in pants,
Feed him on brain food and make him advance.

Hustle him, soon as he's able to walk,
Into a grammar school; cram him with talk.
Fill his poor head full of figures and facts,
Keep on a-jamming them in till it cracks.

Once boys grew up at a rational rate,
Now we develop a man while you wait.
Rush him through college, compel him to grab
Of every known subject, a dip and a dab.

Get him in business and after the cash,
All by the time he can grow a mustache.
Let him forget he was ever a boy,
Make gold his God and its jingle his joy.

Keep him a-hustling and clear out of breath,
Until he wins—Nervous prostration, and death.

—From "*The King's Business.*"

[1] Moorehead, J., *Traumatic Surgery*, p. 760.

1. *Causes of Neurasthenia.*

a. The strenuous, high-tension life of to-day. This does not mean that nervous exhaustion and neurasthenia are due to hard physical work. The day laborer is not troubled with neurasthenia—he can't afford it! It is the individual who uses his finer accessory muscles and neglects to use his larger muscles who is troubled with nervous disorders. He worries, loses sleep, meets with bitter disappointments, is overambitious, is weighed down with the monotony of daily routine tasks, finds that his work is not the expression of his desires, realizes that his body and mind tire under the mad whirl, etc. This lack of adjustment is seen in children and in adults. The child whose health is good and who devotes a major portion of his leisure time to wholesome physical activity is not troubled with nervous exhaustion. It is the children of the "Lord Fauntleroy" type who are often neurotic. The adult who has learned not to take life too seriously and who engages in wholesome physical activity and recreation is not so liable to suffer nervous exhaustion as the one who is constantly taxing his mental faculties without allowing sufficient activity of the larger muscles of his body.

b. Inherent nervous weakness and unstable nervous system. Heredity may account for this condition. The question of environment must also be considered in the cases of nervous children of nervous parents. It is not too much to say that a large number of nervous conditions may be prevented by proper training of children in the home and school. Because of our high-tension living the children of to-day should be taught relaxation.

c. School adjustments. Large classes of children present a difficult pedagogical problem. The so-called average child determines, in many schools, the quantitative curriculum. The bright children are held back and the subnormals are exposed to work beyond their capacities.

d. Physiological disturbances. Impaired functions or disease of the bodily organs must be considered as causative factors in neurasthenia. Disturbances of the gonads and insufficiency of the adrenal glands are said to have a bearing on neurasthenia in children.

e. Psychic shocks or traumatic neurosis. The sight of accidents, etc., where there is a predisposition of dementia, may be the "last straw" in a condition which needs but a slight disturbance to cause the breakdown.

f. Selfishness. The selfish individual tends almost inevitably to an abnormal and cramped outlook, and usually to loneliness and subsequent depression.

g. Various other causes may be mentioned which overlap the five causes listed above.

2. *Symphoms of Neurasthenia.*

a. General fatigue. Muscular weakness is very evident. Fatigue is felt

on slight exertion. The hands and eyelids tremble. The reflexes are exaggerated. The grip is weak.

b. Nervousness. Worry is a prominent symptom. This worry may be manifested in lack of concentration, depression, introspection, etc., culminating in morbid fears. Insomnia is an important cause of this condition. Without proper rest the patient fails to restore the body to a normal condition. A constant accumulative fatigue results. When sleep occurs, it is often disturbed by dreams. Thus the bodily processes are rapidly broken down and are not sufficiently restored through rest and sleep.

c. Visceral disturbances. The metabolic processes are not functioning sufficiently. The appetite is poor. Constipation is prevalent. The circulation is disturbed. Palpitation and other irregularities are noted. The headache of the neurasthenic is a dull pressure ache. Imaginary ailments are complained of.

The above three groups are the outstanding symptoms of neurasthenia. True neurasthenia is seen in a combination of the above symptoms.

3. *Treatment of Neurasthenia.*

a. Remove the cause. First a careful medical and psychical examination is necessary if one is to understand the cause; then comes the effort to remove it. In some cases the cause cannot be removed at once, for worry cannot be swept aside on command. Many individuals are constantly fretting over trifles, unable to distinguish between essentials and non-essentials. Others fear that they are not in command of their work; they feel that their work is riding them, rather than that they conrol it. Of course the real cause lies not in the work itself but in the fact that the nervous energy and anxiety which they expend far exceeds the nervous and physical energy necessary to complete the task. It is sadly true that a man can worry harder than he can work. Worry and hurry seem to be potent factors in many cases of neurasthenia, and they cannot be removed at once.

But the following case may be used to illustrate how the worry habit was finally removed in a case of a man of thirty-five years of age. This man was very wealthy, well educated, and selfish; he had all the symptoms of the typical "nervous American business man." After trying various "cures," he found in the following advice the solution of his problem.

Does your worry concern the necessity for a decision NOW or at some future time? If the problem must be answered at some future time, lay it aside until the time for a decision is very close at hand. If it demands an answer NOW, answer it as best you can—and then do not constantly wonder whether you did the right thing. Let the decision rest, once and for all.

Decisive action without recourse to any changing of the decision stopped this man's worry. If the decision was to be made in the future the more

pressing things at hand were worked upon and no attention was given to the problem until time brought the question before him.

b. Plan a program for the patient that will call for no greater expenditure of nervous or physical energy than can be accumulated by reasonable rest, work, play, and correct diet.

The necessity for rest and relaxation cannot be too strongly stressed, for the average neurasthenic is unable to rest or relax. Rest for some individuals may demand a trip which takes them away from their business. For others, it may be possible in the midst of their business. In the latter case, specific rest periods must be outlined. Massage is useful for its soothing effects and should precede the rest periods. Massage is used to stimulate the body processes without effort on the part of the patient. Sleep may be made more refreshing if preceded by a neutral bath.

The work hours should be so organized that overexpenditure of energy is avoided. Play and recreation (physical activity) must be given a place in the day's program. In many cases very little physical activity can be endured at the start. The ultimate goal, however, must be the expression of physical activity of the larger muscles.

In general the diet of the neurasthenic should be largely "vegetarian," with the addition of fats, fruits, milk foods, and eggs. Condiments and highly seasoned foods must be avoided. *Diets in specific cases should, of course, be prescribed by the physician.*

The exercise program should be carefully regulated to prevent overstimulation and fatigue. The body vigor must be slowly built up. The average person, upon being told that his nerves need rest and his body needs work, takes too vigorous exercises. These fatigue the body and, because of the "driving" process which is necessary to get the exercises done, fatigue the nerves as well. Many men attempt to crowd into one afternoon an entire week's exercise. In the case of the middle-aged men this is not only illogical but often extremely dangerous. Their bodies will not stand the strain.

Outdoor life, swimming, walking, and play with cheerful companions amid pleasant surroundings will do more to bring a person back to normalcy than formal exercises done indoors. But, when it is not possible to engage in outdoor exercises, formal remedial exercises can be given providing the elements of skill and excessive concentration are not demanded. Easy rhythmical exercises are helpful even though they require a certain amount of nervous expenditure for learning the movements. The patient should be helped to get his mind from his worries, and concentration on movements which are not laborious may give him just the right distraction. The lighter games such as volleyball, dodgeball, etc., are exceedingly valuable at first, but in the progression a patient may advance to handball, tennis, and even

boxing and wrestling. These games are valuable because of the physical development which results. They are more valuable because of the poise and self-confidence which come with the ability to handle the body well. Care must be taken, however, to avoid giving the patient exercises which he cannot accomplish. Failure is depressing, and all depression must be avoided.

The following are some of the exercises which are used for cases of neurasthenia when it is impossible to exercise the student in outdoor games.

1. Position: Standing, with the feet apart, hands on hips.

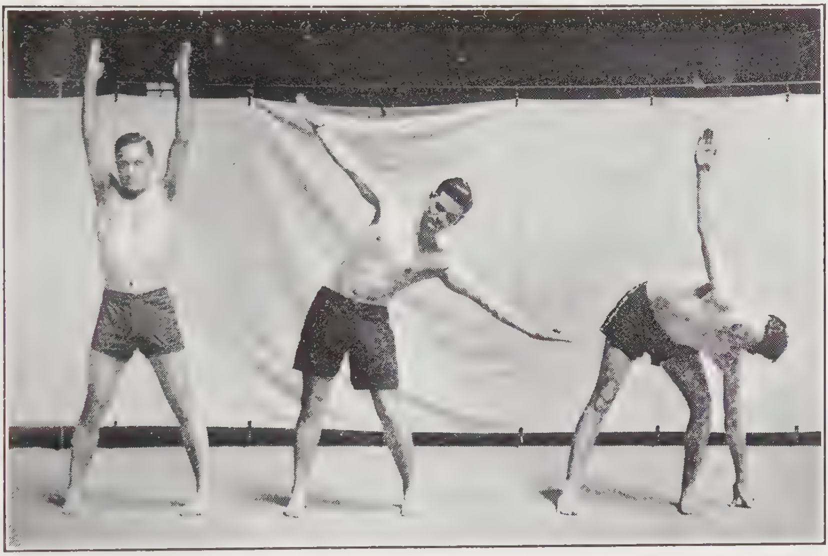

FIGURE 74
Exercise No. 2

Action: Body or trunk circumduction. Bend the body to the right side and then forward, and exhale. Swing body to the left side, draw abdomen well in, and return to original position; inhale. Repeat, going to left side first.

2. Position: Same as above, only hands are extended above the head.

Action: Bend body to right side, bending right knee and touching floor with right hand, left hand pointing toward the ceiling; exhale. Return to original position, reaching well out and up with the right hand; inhale. Repeat on opposite side.

3. Position: Right foot eighteen inches forward, knee bent, left arm stretched forward on level with shoulder, right arm to the rear.

Action: Jump change. Left foot and right arm are forward, right foot and left arm are to the rear. Jump back to original position. Continue in rhythm. Breathe freely throughout the exercise.

4. Position: Feet apart, right knee bent, right arm extended obliquely right toward ceiling, left knee straight and left arm bent, with left elbow close to side and palm facing the left shoulder.

Action: Straighten right knee, bend left knee, thus shifting weight to the left, extend left arm oblique left toward ceiling, bend right forearm on upper arm.

Remarks: The emphasis is on the contraction of the biceps of the bent arm and on the extension of the triceps of the straight arm. One exhalation is executed in this position. The inhalation is taken as the change is made from right to left body weight position.

5. Various light rhythmical arm movements and leg movements may be used to stimulate the body processes, providing there is not too much emphasis on highly coördinated movements.

B. Visceral Psychoneurosis

This is a condition of mental disorder which causes a person to believe that some body organ is affected with some form of disease, when in reality it is not. Charlatans and quacks become rich by treating these cases. The vegetative processes of the body are involuntary, and a definite concentration of the thought on any one process is not necessary for its function. The stomach works without our thinking about digestion. But when a patient is constantly thinking of disease rather than health, there is a great deal of introspection and he may soon believe firmly that he is ill. The labels on many patent medicine bottles are enough to start many gullible individuals toward a tuberculosis sanitarium.

The abuse of leisure time is a big factor in the cause of visceral pschoneurosis. Not enough work to keep them busy will start many individuals on an introspection tour of the body. Then they find symptoms of all forms of disease. The patient visits his doctor, who often finds no objective or even subjective symptoms of the disease about which the patient complains. The patient feels that the doctor is holding back some bitter truth. Then—fear and worry begin to undermine the general health of the individual.

1. *Treatment of Visceral Psychoneurosis.*

When this patient comes to the gymnasium, the best thing that can be done for him is to give him something to do. Moreover, his complaints must not be passed over lightly, for sympathy is necessary if the good-will and confidence of the patient are to be secured. A real man-to-man understand-

ing and a logical explanation of facts will help the average patient. The gymnasium treatment is better than sending the patient away for a vacation. He *needs to do something*, not necessarily to see something.

The specific treatment is as follows:

a. Avoidance of activity which requires too much skill and coördination. Exhausting games are not advocated.

b. Outdoor games and recreation. These are valuable in giving the patient something to do and in building up the body tone.

c. Remedial exercises as given for the neurasthenic. The question is often raised as to the contribution which physical education may make to mental improvement. Dr. Burnham says, "The modern study of psychology and mental hygiene has put a tremendous emphasis on the significance of the various forms of motor activity, and especially what we call physical exercise. Its educational, mental, and moral significance is greater than any, except perhaps a few of its most enthusiastic devotees, have imagined. Physical education should give the fundamental basis of psychological development from which special forms of motor skill can be healthfully differentiated. It should in a large degree furnish the raw material for the higher thought processes, not only motor images and experiences of many concrete situations, but the psychological attitudes that lie at the foundation of efficiency, mental health and morality, and permanent interests that will carry over into life. It should develop that supreme condition of physical and mental health that we only suggest by the use of the word 'morale' in its highest and broadest meaning."[1]

Action being the secret of growth, it is necessary that the better the body is the better the nutritive system is, and the better the nutritive system is the better the body and the mind. For proper use of the brain physical education is necessary to provide a substantial organism to support the brain activities. The tremendous drain on the mental resources necessitates nourishment to the brain. By physical education the circulation is stimulated, and better nourishment is provided for the brain. Without this adjustment, sooner or later a break occurs because physiological law cannot be broken for too long a time and the brain cannot get its nourishment at the expense of the body without a loss of proper biological and physiological balance. Physical education not only builds the muscular system and tones the vital organs but it strengthens the nerve cells, thus making a well rounded balance of education and proper fulfillment of life's functions. Thus physical education causes a useful change in the organism of which the individual is conscious, and becomes truly educational.

[1] Burnham, W., "The Newer Aims of Physical Education and Its Psychological Significance," *Amn. Phy. Educ. Rev.*, January, 1922.

With the idea of increasing the body tone the following formula should be kept constantly in mind:

Mental

Control Control

Physical

To increase one is to increase the other. Since the physical is more tangible than the mental, it is easier to begin with the reëducation of the physical.

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